RECONCILING ANTHROPOMETRIC AND TAILORING MEASUREMENTS FOR CLOTHING DESIGN
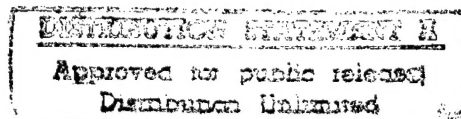
prepared for

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under contract no SPO100-95-D-1010
Delivery Order 0004

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27 May 1997

19971028 019

REPORT DOCUMENTATION PAGE

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 27 May 97	3. REPORT TYPE AND DATES COVERED Final Report 02 Aug 96 – 27 May 97

4. TITLE AND SUBTITLE

Reconciling Anthropometric and Tailoring Measurements for Clothing Design

5. FUNDING NUMBERS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Defense Logistics Agency
MMPRT Room 3135
8725 John J. Kingman Road, #2533
Fort Belvoir, VA 22060-6221

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 Words)

Over the years, the U.S. military services have acquired a large body of anthropometric data, much of it for application to the design and sizing of military clothing. These data have not, however, been as fully utilized as they might have been because a number of measurement definitions used by anthropologists are unfamiliar to expert tailors who traditionally measure the same dimensions or their equivalents quite differently. The goal of this research was to document the relationship between anthropological measurements and tailoring measurements, not only identifying similarities and differences between measurement techniques, but quantifying the relationship mathematically, so it would be possible to take an anthropological measurement and convert it to an equivalent tailoring measurement. A group of 127 U.S. Army recruits (60 males and 67 females) was measured for some two dozen dimensions relevant to military dress clothing, using both anthropological and tailoring techniques. Resulting values were compared and differences between the two techniques were quantified. The final product is a set of four conversion tables which convert anthropological measures into tailoring measures, anf vice versa, for men and for women.

14. SUBJECT TERMS

anthropometry, tailoring, measurements, clothing

15. NUMBER OF PAGES 150

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

NSN 7540-01-280-5500

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PREFACE

This document is the final report of Project T1P1, "Standardize Anthropometric Measurements" of the Design and Development Focus Group, Apparel Research Network. It represents a collaborative effort between Anthropology Research Project, Inc. (ARP), and HAAS Tailoring Company (HAAS).

No collaborative research of this kind can succeed without the help of many people, both up front and behind the scenes. The author would like to thank Joseph DeBlase of HAAS Tailoring Company for his help in getting the study underway, and his support throughout. Michael Snyder from HAAS and (ARP) anthropometrists Belva Hodge, Shirley Kristensen, and Ann Lisa Piercy patiently and meticulously measured the subjects and recorded the data that provided the foundation of this research.

The author is grateful too for the unfailing cooperation of U.S. Army personnel who smoothed the way for us at Fort Jackson, South Carolina: Cordelia Lattimore of TRADOC who provided the needed permission; Ruby Ramsay, Director of Logistics, Supply and Services Division, Ft. Jackson, S.C. who made everything easy for us by facilitating arrangements at the site, and Lonnie Turner of the Ft. Jackson CIIP who seemingly pulled building materials and supplies out of a hat to meet the changing needs of the measuring team.

Finally, thanks to ARP editor Ilse Tebbetts and to Belva Hodge for organizing and producing the report.

EXECUTIVE SUMMARY

Over the last five decades, the U.S. military services have acquired a large body of anthropometric data for use in the sizing and design of clothing, equipment, and workspaces. Anthropometric data intended for application to clothing design, however, have not been as fully utilized as they might have been because a number of measurement definitions used by anthropologists are unfamiliar to expert tailors who traditionally measure the same dimensions or their equivalents quite differently.

The goal of this research is to document the relationship between anthropological measurements and tailoring measurements, not only identifying similarities and differences between measurement techniques, but also quantifying the relationship mathematically so that it will be possible to take an anthropological measurement and convert it to an equivalent tailoring measurement.

The research was undertaken in three steps. First, dimensions useful in military dress clothing design were identified. Next, a group of 60 males and 67 females, randomly selected from among U.S. Army recruits at Fort Jackson, S.C., were measured using both anthropological and tailoring techniques. Finally, resulting values were statistically compared and conversion tables were drawn up.

Anthropometric dimensions were selected from among those measured in the most recent comprehensive survey of Army personnel (Gordon et. al, 1988). Measuring methods from that survey were duplicated. In cases where a clothing measurement had no anthropological equivalent (e.g. coat length), anthropological measurements from which to calculate an approximation were selected (e.g. cervicale height minus gluteal furrow height).

Results showed that, for most dimensions, tailoring measurements for both males and females are somewhat larger, as would be expected, since tailors measure clothed subjects and use looser tapes than do anthropologists who use precision instruments to measure near-nude subjects. Clothing also explains why tailors' measurements are smaller in a few cases. This is true, for example, in the case of crotch height, which is measured by anthropologists to the actual crotch of the subject; its tailoring equivalent, inseam, is measured on the garment.

Conversion tables for each pair of comparable dimensions were created by calculating regression equations (also given in this report). Four sets of conversions include separate sets for men and women, each from anthropological measurements into tailoring measurements, and vice versa.

The next phase of this research is to use these conversions along with recent anthropometric data to develop comprehensive sizing systems for men and women's dress clothing. That work will be reported in a subsequent report.

A concern emerged after beginning this research that differences among different tailors might confound the results. While a massive study of many different tailors is beyond the scope of this research, we conducted a small experiment with 3 additional tailors (one military and two civilian) and 1 subject. This quick experiment showed that waist and sleeve length inseams were most consistent among all tailors, but chest and shoulder circumferences were widely divergent. This is an area that warrants further research.

RECONCILING ANTHROPOMETRIC AND TAILORING MEASUREMENTS FOR CLOTHING DESIGN

INTRODUCTION

The U.S. military has a long history of anthropometric data collection, especially in the Army and the Air Force. Large-scale anthropometric surveys were done in 1946 (Army), 1950 (AF), 1957 (AF), 1966 (Army), 1967 (AF), 1968 (AF), 1977 (Army) and 1987 (Army). In each case anthropologists designed the surveys and the measurements were taken by qualified anthropometrists. In the case of the most recent Army survey (ANSUR) (Gordon et al., 1989), considerable care was taken to consult with U.S. Army Natick clothing designers and pattern makers (Clauser et al., 1986) to ensure that appropriate dimensions for clothing design were included in the survey. That consultation also provided input on how the dimensions should be measured. However, the operating assumption at that time was that anthropologists were the experts in measuring human bodies, while clothing designers specialized in creating patterns and design. Thus, the opinions of the clothing designers about how dimensions should be measured were given little weight. As a result, clothing dimensions were defined in ways that were acceptable to anthropologists, but not typical in the clothing industry. Because some of these definitions are unfamiliar to tailoring experts, the information from the ANSUR survey has not been heavily used in tailored clothing design. In order to make these anthropometric data more useful to designers, there is a need to convert, or translate, from anthropometric data to tailoring data.

The Apparel Research Network (ARN) has both short- and long-term goals. Among the long-term goals is total Customer Driven Uniform Manufacture (CDUM), in which individuals can order garments to their own specifications, to be delivered in a very short time. The technology proposed for CDUM is whole-body scanning, in which an individual is rapidly scanned to create a three-dimensional (3D) image on a computer workstation. When the technology is fully developed, the scanned image will form the basis for collecting information about an individual's body shape and size. This information will be fed into pattern creation software, which will either select a pre-existing pattern, or create a pattern for that individual. The body size information extracted from the scanner is direct surface information, and in that sense is similar to the measurements typically used by anthropologists. Thus, to achieve the long-term ARN goals, it is necessary to understand the relationship between surface anthropological measurements and the tailoring measurements needed to create patterns.

The goal of this research, then, was to document the relationship between anthropological measurements and tailoring measurements, not only identifying similarities and differences between measurement techniques, but quantifying the relationship mathematically, so it will be possible to take an anthropological measurement and convert it to an equivalent tailoring measurement.

We used a three-step approach to this research. First, we identified pertinent dimensions, which are useful in military dress clothing design. This domain is the focus of the ARN. Next, we measured a group of recruits, both male and female, using both measurement techniques. Finally, we compared the resulting values statistically, to develop the mathematical relationships between anthropological and tailoring measurements, and drew up conversion tables (both anthropological to tailoring, and tailoring to anthropological). This report is organized into sections corresponding to those steps.

IDENTIFICATION OF DIMENSIONS

Creating a garment design and pattern is as much art as technical skill. The best practitioners can create designs of lasting elegance and utility. Individual designers often go about their craft in unique and subtly different ways. This means that one clothing designer will not always use the same set of body dimensions as another in creating his or her designs. Thus, no single set of standard dimensions can be established for the design of a coat, for example.

This diversity presented a challenge for this project, because we could use only a finite number of dimensions in our analysis. Therefore we sought to develop a consensus list of dimensions which would be

representative of those used in the design of men's and women's dress military uniforms in the U.S. To develop this list we sought the advice of a number of people involved in military garment design, as well as those who develop similar commercial items. The individuals we consulted are listed below:

UNIVERSITY PERSONNEL *	
Jaquelene Robeck, Ph.D.	University of Wisconsin-Stout
Nancy Staples, Ph.D.	Clemson Apparel Research
GOVERNMENT CLOTHING DESIGN	
Steven Israelian	U.S. Army Natick Clothing and Protective Equipment
Sirvart Mellian	U.S. Navy Clothing and Textile Research Facility
Barbara Quinn	U.S. Army Natick Dress Clothing
COMMERCIAL CLOTHING DESIGN	
Joseph DeBlase	Haas Tailoring
Michael McLean	Haas Tailoring
Marc Seinfeld	Haas Tailoring
ANTHROPOLOGISTS	
James Annis	Anthropology Research Project, Inc.
Bruce Bradtmiller, Ph.D.	Anthropology Research Project, Inc.
Steven Paquette	U.S. Army Natick Anthropology Group Leader

*These experts have commercial experience as well.

In addition to consulting the experts cited in the table, we also studied fit test data forms for a variety of garments used by the U.S. Air Force and the U.S. Navy. These forms list dimensions to be measured in connection with the fit test; they are the dimensions considered by the garments' designers to be crucial for garment fit. Finally, we coordinated our dimension selection efforts with people working on a related ARN project "Extract Measurements from 3-D Scans" (Design and Development Focus Group, Project T2P5), to ensure that the conversion equations we developed in this project would also be those needed by the software engineers extracting traditional measurements from the whole body scan data. The resulting matched measurement list is shown in Table 1. The anthropology measurements are fully described in the measurer's handbook for this project, which appears as Appendix A. The tailoring measurements are defined in Appendix B. Note that there are some differences in terminology between the two techniques.

Some tailoring dimensions do not have a direct anthropological equivalent. In these cases, the anthropological equivalent was calculated from other dimensions. For example, coat length is calculated as cervicale height minus gluteal furrow height; inside sleeve length is calculated as axilla height minus wrist height. (Exact formulas and other calculated dimensions are shown in the section entitled DATA ANALYSIS AND RESULTS.) The tailoring tradition is to make bilateral measurements on both sides, while anthropologists generally use only the right side. Anthropological stature and weight are measured, while the tailoring tradition is to ask the subject for those values. The tailoring custom is to measure the pant outseam (waist to floor) at both sides, and then measure the front of the slacks waistband to the floor and the back of the slacks waistband to the floor. In the anthropological tradition, the waist is established as a horizontal plane. Thus, measurement to the floor at any point on the waist should yield the same value.

TABLE 1

Dimensions Measured on the Test Sample

MALES

ANTHROPOLOGICAL MEASUREMENTS	TAILORING MEASUREMENTS
Buttock Circumference	Seat
Chest Circumference	Chest Circumference
Coat Length*	Coat Length
Crotch Height	Crotch Height (Inseam), Left*
Inside Sleeve Length, Right*	Inside Sleeve Length, Left
Inside Sleeve Length, Right*	Inside Sleeve Length, Right
Rise, NI*†	Rise
Shoulder Circumference	Overarm
Shoulder Slope, Right*	Shoulder Slope, Left
Stature	Height (reported)
Waist Circumference, NI	Coat Waist
Waist Circumference, O†	Waist Circumference
Waist Height, O	Back-Floor Height
Waist Height, O	Front-Floor Height
Waist Height, NI	Outseam, Left
Waist Height, NI	Outseam, Right
Weight	Weight (reported)

FEMALES

ANTHROPOLOGICAL MEASUREMENTS	TAILORING MEASUREMENTS
Biceps Circ, Flexed	Biceps Circ, Flexed
Bust Position*	Bust Position
Buttock Circumference	Seat
Chest Circumference	Bust Circumference
Chest Circumference, Scye	Chest Circumference
Coat Length*	Coat Length
Crotch Height	Crotch Height, Left*
Front Waist Length, O*	Front Waist Length
Inside Sleeve Length, Right*	Inside Sleeve Length, Left
Inside Sleeve Length, Right*	Inside Sleeve Length, Right
Interscye II	Point to Point
Rise, NI*	Rise
Shoulder Slope, Right*	Shoulder Slope, Left
Shoulder Slope, Right*	Shoulder Slope, Right
Skirt Length, NI*	Skirt Length
Stature	Height (reported)
Waist Circumference, NI	Waist Circumference
Waist Height, O	Back-Floor Height
Waist Height, O	Front-Floor Height
Waist Height, NI	Outseam, Left
Waist Height, NI	Outseam, Right
Weight	Weight (reported)

*Calculated dimensions.

†NI= natural indentation; O=Omphalion.

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One of the key goals of this project is to develop clothing measurements from existing anthropological data. Since the most recent and most thorough anthropological data set is the Army's 1987-1988 ANSUR survey, it was critical for this project to use the same definitions for the anthropological measurements that were used in that survey. They were defined in Clauser (et al., 1988) and Gordon (et al., 1989). For ANSUR, it was not possible to come to agreement among experts about the best definition of the waist. As a result, all waist dimensions were measured twice -- once for each definition of waist: (1) the level of the navel (omphalion), and (2) the natural indentation of the torso. In the tailoring tradition, it is customary to let the customer determine his or her own waist. For men, the preferred waist is closest to ANSUR's omphalion waist. For women, the customer's preferred waist is closer to ANSUR's natural indentation waist. It should be emphasized, however, that individuals differ in where they prefer to wear their slacks or skirts, so there is considerable variability in the subject's preferred waist. Needless to say, this presents a problem in determining an exactly comparable anthropological dimension.

DATA COLLECTION

In February, 1997, 60 male and 67 female U.S. Army recruits were measured in the Clothing Initial Issue Point (CIIP) at Jackson, South Carolina. The recruits had been in the army approximately five weeks. The subjects were randomly selected by the CIIP supervisors from among recruits waiting for uniform fitting and distribution. After the survey was explained to them, and they signed a consent form, the subjects were measured for tailoring dimensions in their physical training (PT) shirt and shorts by a HAAS Tailoring Company representative using tailoring methods. Tailoring measurement is illustrated in Figure 1. Afterwards, they were measured for comparable anthropological dimensions by an ARP anthropometrist using ANSUR methods. The anthropological method is illustrated in Figure 2.
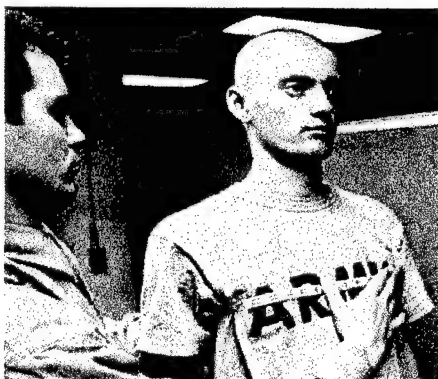
Figure 1. Tailoring Measurement

Figure 2. Anthropological Measurement

Where there was no comparable ANSUR dimension, dimensions were chosen from which to calculate an approximation of the dimension in question. For anthropological measuring, the males wore PT shorts. The females wore a tank top provided by ARP, and PT shorts. Wherever possible, the measurements were skin measurements. The specific procedures used by the two organizations are found in Appendices A and B, as noted.

Tables 2 and 3 summarize the age and race distribution of the sample. These are distributions that approximately represent the population of U.S. Army basic trainees. Note that it is not important that these individuals be representative of the army as a whole. The purpose of the study is to compare methods, so the specific distribution of the sample, so long as it is reasonable, is not important. Rank was not collected on the data form because we assumed that all the subjects would be E-1's. This turned out not to be the case, and we found through conversation that we had some subjects as high as E-4. When age and race are accounted for, however, rank does not have an effect on body size.

TABLE 2

Age Distribution of Test Sample

AGE	MALE	FEMALE
≤19	24	32
20-24	24	25
25-29	8	5
30-35	4	5

TABLE 3

Racial/Ethnic Distribution of Test Sample

RACE	MALE	FEMALE
WHITE	34	33
BLACK	11	19
HISPANIC	13	12
PACIFIC IS.	1	2
MIXED	1	1

DATA ANALYSIS AND RESULTS

During the anthropological measuring session, each subject's data were subjected to two levels of editing. An entered value was immediately checked against the ANSUR minimum and maximum for that dimension. Values which exceeded the minimum or maximum were flagged to allow a remeasure. When all the measurements for a subject were complete, each measured value was checked against a predicted value for that dimension for that subject. The predicted values were derived by regression equations, in which the dimension in question was the dependent variable, and two other highly correlated dimensions were the independent variables. When a measured value differed from a predicted value by more than a preset amount, the value was flagged, and the measurers were given an opportunity to remeasure. This allowed the measurer to check flagged dimension values before the subject was dismissed.

After data collection was complete, each database (tailoring and anthropological with sexes separate) was edited using two ARP software programs, XVAL and EDIT. These programs check for extreme values and inconsistencies within a subjects data set, using regression equations calculated from the data collected. In all, twelve subjects were flagged, and of these, five values clearly caused by observer error were changed. If the dimension had been remeasured (*i.e.*, the unusual value was verified on the subject), no change was made.

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As noted above, it was necessary to calculate some dimensions in order to be able to compare the tailoring data with the anthropological data. When there was a choice of dimensions to be used in the calculations (as in the case of the two waists), we calculated both, and chose the one whose tailoring-anthropological regression equation had the lowest standard error.

In the tailoring data set, crotch height (inseam) was calculated by subtracting the measured rise from outseam length, left and right. The standard error from the regression equations predicting the tailoring crotch height from anthropological crotch height was lowest for the combination using outseam length, left, for both males and females. Therefore, this is the crotch height calculation used in the comparison analysis.

For the anthropological data set, the list below shows the calculated variables and how they were derived. Where there are two waists, NI refers to the natural indentation, and O refers to omphalion (the navel).

Males and Females:

Coat Length	=	Cervicale Height	-	Gluteal Furrow Height
Inside Sleeve Length	=	Axilla Height	-	Wrist Height
Rise, NI	=	Waist Height, NI	-	Crotch Height
Shoulder Slope	=	Neck Height, Lateral	-	Acromial Height

Females:

Bust Position	=	1/2 Strap Length		
Front Waist Length, O	=	1/2 Strap Length	+	(Chest Height - Waist Height, O)
Skirt Length, NI	=	Waist Height, NI	-	Knee Height, Midpatella

We calculated summary statistics for each of the four data sets. The results appear in Appendix C, in which male data are shown in Tables C-1 (anthropological) and C-2 (tailoring), and female data are shown in Tables C-3 (anthropological) and C-4 (tailoring). In the tables displaying the anthropological measurements, comparison means and standard deviations for ANSUR are shown. The male recruits in this study are slightly smaller than the ANSUR sample in most dimensions, while the female recruits are essentially the same as the ANSUR sample for most dimensions.

Tables 4 and 5 show comparison values for the anthropological and tailoring measurements for males and females respectively. For the males, the tailoring measurements are generally larger. This is the expected result, since the tailoring tradition is to take the measurements over clothing, and to take them with a generally looser tape. Exceptions to this general rule are: crotch height, where tailors generally measure to the slacks inseam which is lower than the actual crotch; the inside sleeve lengths, again because the tailoring measurement is to the seam of the sleeve, and not the actual underarm; and rise for the same reason. The only other dimension in which the tailoring value is smaller is the front-to-floor (compared to anthropological waist height). Here the difference is apparently due to the fact that most males wear their slacks tilted slightly down in front, whereas the anthropological dimension is measured on the horizontal plane. We tested these differences statistically, and found that they were all significantly different from each other at the 0.001 level, using the paired sample t-test. Correlations between the anthropological and tailoring dimensions are shown in the final columns of Tables 4 and 5, and all are significantly different from zero at the 0.01 level. Most of the correlation coefficients are greater than 0.9. This indicates that the two techniques are producing generally similar results. Coat length and inside sleeve length are between 0.8 and 0.9. The lower level of these correlations, we suspect, has to do with the fact that these dimensions are related more closely to the garment than to the body. The shoulder slopes were 0.6 and 0.5 (right and left, respectively). Although this dimension is called shoulder slope, in fact it represents the difference in height between the neck and the shoulder. The low level of this correlation is due to a fundamentally different technique. The anthropological approach is to take the height of the side of the neck, and subtract the

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TABLE 4

Anthropological and Tailoring Mean, SD, Mean Difference, t, and Correlations: Males
(n=60; weight in pounds, all others in inches)

COMPARED DIMENSIONS		ANTHROPOLOGICAL		TAILORING		PAIRED-SAMPLE t-TEST		CORRELATION**
Anthropological	Tailoring	Mean	SD	Mean	SD	Mean	t*	
Buttock Circumference	Seat	37.85	2.98	40.13	3.03	-2.28	-24.785	.972
Chest Circumference	Chest Circumference①	38.11	2.98	41.25	3.21	-3.14	-35.955	.979
Coat Length①	Coat Length	27.36	1.41	30.06	1.06	-2.70	-26.307	.867
Crotch Height, Left	Crotch Height	32.68	2.18	31.76	1.90	0.92	8.872	.931
Inside Sleeve Lgth, Right①②	Inside Sleeve Lgth, Left	18.73	1.28	17.92	1.24	0.81	9.323	.857
Inside Slve Lgth, Right①	Inside Slve Lgth, Right	18.73	1.28	18.02	1.23	0.70	8.379	.866
Rise, NI①	Rise	11.15	0.84	10.39	0.70	0.76	7.902	.548
Shoulder Circumference	Overarm	45.81	3.00	47.08	3.02	-1.27	-12.033	.963
Shoulder Slope, Right①②	Shoulder Slope, Left	2.20	0.50	2.66	0.43	-0.46	-7.682	.511
Shoulder Slope, Right①	Shoulder Slope, Right	2.20	0.50	2.65	0.50	-0.45	-8.208	.643
Stature	Height (reported)	68.37	3.07	69.55	3.29	-1.18	-13.169	.978
Waist Circ, NI (n=59)	Coat Waist	31.86	3.08	33.62	3.30	-1.74	-17.945	.975
Waist Circumference, O	Waist Circumference	32.76	3.50	33.57	2.94	-0.80	-6.285	.968
Waist Height, O	Back-Floor Height	41.32	2.39	42.26	2.32	-0.94	-9.589	.948
Waist Height, O	Front-Floor Height	41.32	2.39	40.78	2.23	0.54	4.925	.935
Waist Height, O	Outseam, Left	41.32	2.39	42.15	2.21	-0.83	-9.071	.956
Waist Height, O	Outseam, Right	41.32	2.39	42.22	2.21	-0.91	-9.283	.949
Weight (reported)	Weight (n=59)	160.43	29.90	163.81	29.75	-3.75	-11.028	.996

* All paired-sample t-tests are significant at .001.

** All correlations are significant at .01 level.

① Calculated dimensions.

② Measured right side only.

TABLE 5

Anthropological and Tailoring Mean, SD, Mean Difference, t, and Correlations: Females
(n=67; weight in pounds, all others in inches)

COMPARED DIMENSIONS		ANTHROPOLOGICAL		TAILORING		PAIRED SAMPLE t-TEST		CORRELATION**
Anthropological	Tailoring	Mean	SD	Mean	SD	Mean Diff	t*	
Bicep Circumference, Flexed	Bicep Circ, Flexed	11.16	0.91	11.78	0.94	-0.62	-13.860	.922
Bust Position①	Bust Position	13.27	0.99	14.06	0.98	-0.79	-15.640	.910
Buttock Circumference	Seat	38.34	2.26	39.96	2.11	-1.62	-15.238	.923
Chest Circumference	Bust Circumference	36.21	2.5939	37.56	2.44	-1.35	-12.875	.943
Chest Circumference, Scye	Chest Circumference	35.77	2.16	36.64	2.01	-0.87	-7.232	.891
Coat Length① (n=57)	Coat Length	25.77	1.09	27.51	1.07	-1.80	-24.914	.870
Crotch Height	Crotch Height, Left[1]	30.81	1.75	30.94	1.81	-0.14	-1.101②	.839
Front Waist Length, O①	Front Waist Length	21.23	1.21	21.71	1.38	-0.47	-3.546	.655
Inside Sleeve Lgth, Right①②	Inside Sleeve Length, Left	17.50	1.19	17.10	1.12	0.40	4.945	.840
Inside Sleeve Lgth, Right ①	Inside Sleeve Length, Right	17.50	1.19	17.20	1.13	0.30	3.699	.837
Interseye II	Point to Point	14.93	0.91	17.88	0.73	-2.95	-33.729	.644
Rise, NI①	Rise	10.20	0.77	10.46	0.55	-0.26	-2.383④	.158
Shoulder Slope, Right①②	Shoulder Slope, Left	1.73	0.28	2.48	0.32	-0.75	-19.855	.481
Shoulder Slope, Right①	Shoulder Slope, Right	1.73	0.28	2.47	0.39	-0.74	-17.694	.516
Skirt Length, NI① (n=66)	Skirt Length	23.24	1.23	24.08	1.22	-0.85	-5.932	.549
Stature	Height (reported)	63.76	2.25	64.45	2.39	-0.68	-7.595	.951
Waist Circumference, NI	Waist Circumference	28.97	2.42	30.84	2.47	-1.87	-12.205	.869
Waist Height, NI	Back-Floor Height	41.01	2.07	41.04	1.92	-0.03	-0.268③	.877
Waist Height, NI	Front-Floor Height	41.01	2.07	39.89	2.03	1.12	7.762	.834
Waist Height, NI	Outseam, Left	41.01	2.07	41.40	1.95	-0.39	-2.819⑥	.842
Waist Height, NI	Outseam, Right	41.01	2.07	41.50	1.96	-0.49	-3.414	.830
Weight	Weight (reported)	138.20	19.12	137.58	18.56	0.62	0.907③	.956

*   All paired-sample t-tests are significant at .001 unless otherwise noted.
** All correlations are significant at .01 level, except Rise.
① Calculated dimensions.
② Measured right side only.
③ Not significant.
④ Significant at 0.05.
⑥ Significant at 0.01.

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height of the shoulder. The tailoring approach uses a special tool involving a bubble level. Finally, the rise had a correlation in the 0.5 range. The level of this correlation has to do with a methodological compromise required for this study. The tailoring approach generally takes this dimension with slacks on, and measures from the existing trousers, adjusting for those cases in which the fit of the trousers is not ideal. Here, because of the subject flow at Ft. Jackson, we were not able to access subjects while they were wearing their dress slacks. As a result, the tailoring measurer was forced to estimate where the inseam of the trousers would have fallen. The result of this was a low correlation with the anthropological measure.

Comparing the female values (Table 5), the tailoring measurements are again generally larger. The exceptions include inside sleeve length, and the front-to-floor distance for the same reasons given for males. Note that for females, the waist measurements generally had better comparisons with the natural indentation anthropological waist. A final exception is weight, where the female recruits reported weights for the tailoring measurements at just over one-half pound lighter than they actually were. This difference was not significantly different using the t-test. The differences for crotch height and back-to-floor height were also not significantly different. All the other dimensions were different at the 0.001 level except rise (significant at 0.05) and left outseam (significant at 0.01). All correlations except rise are significantly different from zero at the 0.01 level. For the women, most of the correlation coefficients were in the 0.8 to 0.9 range, lower than those of the men. The dimensions which had correlations above 0.9 were: biceps circumference, bust circumference, bust position, seat, height, and weight. There were two correlations in the 0.6 to 0.7 range: point to point and front waist length. Both the shoulder slopes were near 0.5, and skirt length was between 0.5 and 0.6. Again, aside from shoulder slope, where the technique is fundamentally different, the dimensions with the lower correlation coefficients are those that have more to do with the garment than with the body. Finally, the correlation coefficient for rise was 0.16. This is extremely low, but here represents a fundamentally different technique. The anthropological approach is the same as for the men, where the bar of the anthropometer is placed high in the subject's crotch while he or she is standing. The tailoring approach to rise in women is to measure the height of the waist while the subject is seated on a table. Since this technique is so different, it is not surprising that the correlation is so low.

DIMENSION CONVERSIONS

Examining mean differences is an interesting way to understand the rough differences between the two measurement techniques, but it is not useful in an individual case. Just because the tailoring seat circumference is, on the average, 2 ¼ inches larger than the corresponding anthropological buttock circumference does not mean that for any individual one could obtain the correct tailoring dimension just by adding 2 ¼ inches to the anthropological measurement. To make these conversions, and to make them reliably, we have calculated regression equations. These equations take into account differences on the mean, but they also take into account dispersion of data points around a mean value. (See plots in Appendix D.) Essentially, the regression equation expresses a mathematical relationship between the two dimensions. These regression equations are of the form:

$$y = m*x + b$$

where y is the predicted dimension
        m is the slope of the regression line
        x is the predictor, or independent dimension; and
        b is the y-intercept of the line.

A complete discussion of the theory and calculation of regression equations can be found in any introductory statistics text. An example of such an equation is:

seat (tailoring) = 0.988 * buttock circumference (anthropological) + 2.727

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For a person whose anthropological buttock circumference is 35 inches, the equivalent tailoring dimension would be: 37.307. The calculation is as follows:

seat (tailoring) = (0.988 * 35) + 2.727
seat (tailoring) = 34.58 + 2.727
seat (tailoring) = 37.307 inches

All of the equations for converting anthropological dimensions into tailoring dimensions are listed in Tables 6 (males) and 7 (females). The right-most column contains the standard error, which is an estimate of the efficiency of the prediction. In the case of the example seat/buttock circumference, the standard error is 0.718, which means that the actual predicted tailoring dimension is 37.307 plus or minus 0.718 inches. A lower standard error means the equation is more reliable; a higher standard error means an equation is less reliable. The lowest standard errors were found for shoulder slope (0.24 inches, females; 0.38 inches, males), while the highest were found for waist (1.27 inches, females; .81 inches, males), with most values in the 0.6 inch to 0.9 inch range. Tables 8 (males) and 9 (females) show similar tables, but there the equations convert tailoring dimensions into anthropological dimensions.

While these equations are the most accurate way to represent these conversions, they can be cumbersome to use. Tables 10 through 25 (males) and 26 through 45 (females) are conversion charts which allow approximations of the tailoring values, based on specific values of the anthropological measurements. Tables 46 through 63 (males) and 64 through 83 (females) convert specific values of tailoring measurements to approximate anthropological measurements.

The plots in Appendix D are an alternate way of obtaining the conversions listed in Tables 10-83. Each subject was plotted at a point that represents the anthropological and tailoring measurements for a given set of matched dimensions. A regression line (line of best fit) is drawn through the population and can be used to convert one kind of measurement into its equivalent value in the other. Thus, for example, for anthropological chest circumference (page 125) a vertical line ca be drawn from 36 (the anthropological measurement) to the regression line. A horizontal line drawn from that point to the vertical axis will emerge at 39 (the tailoring measurement). Furthermore, since an overwhelming number of values on this plot are clustered close to the regression line, one can deduce that the correlation between anthropometric and tailoring measurements for this dimension is high and, thus, that the regression equation on which the conversions are based is highly reliable. Viewing plots of such dimensions as rise (page 131) and shoulder slope (page 132) can draw the opposite conclusion, both caused by problems discussed above.

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TABLE 6

Tailoring Dimension Prediction Equations: Males
(weight in pounds, all others in inches)

TAILORING DIMENSION	=	SLOPE	x	ANTHROPOLOGICAL DIMENSION	+	INTERCEPT	STANDARD ERROR
Back-Floor Height	=	0.921	x	Waist Height, O	+	4.200	0.744
Chest Circumference	=	1.054	x	Chest Circumference	+	1.068	0.662
Coat Length	=	0.983	x	Coat Length①	+	3.169	0.802
Coat Waist	=	1.035	x	Waist Circ, NI	+	0.618	0.743
Crotch Height, Left	=	0.813	x	Crotch Height	+	5.179	0.699
Front-Floor Height	=	0.871	x	Waist Height, O	+	4.784	0.800
Height	=	1.048	x	Stature	+	-2.125	0.685
Inside Sleeve Lgth, Left	=	0.833	x	Inside Sleeve Lgth, Right①	+	2.321	0.644
Inside Sleeve Lgth, Right	=	0.833	x	Inside Sleeve Lgth, Right①	+	2.427	0.618
Outseam, Left	=	0.885	x	Waist Height, O	+	5.589	0.659
Outseam, Right	=	0.876	x	Waist Height, O	+	6.011	0.701
Overarm	=	0.969	x	Shoulder Circumference	+	2.708	0.818
Rise	=	0.458	x	Rise, NI①	+	5.284	0.595
Seat	=	0.988	x	Buttock Circumference	+	2.727	0.718
Shoulder Slope, Left	=	0.441	x	Shoulder Slope, Right①	+	1.690	0.374
Shoulder Slope, Right	=	0.644	x	Shoulder Slope, Right①	+	1.232	0.387
Waist Circumference	=	0.812	x	Waist Circumference, O	+	6.980	0.747
Weight	=	0.987	x	Weight	+	5.800	2.603

① Calculated dimensions.

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TABLE 7

Tailoring Dimension Prediction Equations: Females
(weight in pounds, all others in inches)

TAILORING DIMENSION	=	SLOPE	x	ANTHROPOLOGICAL DIMENSION	+	INTERCEPT	STANDARD ERROR
Back-Floor Height	=	0.812	x	Waist Height, NI	+	7.752	0.929
Biceps Circ, Flexed	=	0.956	x	Biceps Circ, Flexed	+	1.112	0.367
Bust Circumference	=	0.892	x	Chest Circumference	+	5.275	0.818
Bust Position	=	0.909	x	Bust Position①	+	2.002	0.411
Chest Circumference	=	0.831	x	Chest Circumference, Scye	+	6.915	0.922
Coat Length	=	0.867	x	Coat Length①	+	5.215	0.530
Crotch Height, Left	=	0.870	x	Crotch Height	+	4.150	0.992
Front-Floor Height	=	0.817	x	Waist Height, NI	+	6.401	1.127
Front Waist Length	=	0.745	x	Front Waist Length, O①	+	5.880	1.050
Height	=	1.011	x	Stature	+	-0.006	0.742
Inside Sleeve Lgth, Left	=	0.786	x	Inside Sleeve Lgth, Right①	+	3.338	0.613
Inside Sleeve Lgth, Right	=	0.793	x	Inside Sleeve Lgth, Right①	+	3.328	0.624
Outseam, Left	=	0.792	x	Waist Height, NI	+	8.902	1.059
Outseam, Right	=	0.786	x	Waist Height, NI	+	9.286	1.101
Point to Point	=	0.516	x	Interscye II	+	10.168	0.566
Rise	=	0.112	x	Rise, NI①	+	9.309	0.548
Seat	=	0.860	x	Buttock Circumference	+	6.970	0.816
Shoulder Slope, Left	=	0.558	x	Shoulder Slope, Right①	+	1.512	0.285
Shoulder Slope, Right	=	0.719	x	Shoulder Slope, Right①	+	1.222	0.334
Skirt Length	=	0.542	x	Skirt Length, NI①	+	11.496	1.028
Waist Circumference	=	0.884	x	Waist Circumference, NI	+	5.225	1.231
Weight	=	0.985	x	Weight	+	1.399	5.622

①Calculated dimensions.

TABLE 8

Anthropological Dimension Prediction Equations: Males
(weight in pounds, all others in inches)

ANTHROPOLOGICAL DIMENSION	=	SLOPE	x	TAILORING DIMENSION	+	INTERCEPT	STANDARD ERROR
Buttock Circumference	=	0.956	x	Seat	+	-0.516	0.706
Chest Circumference	=	0.909	x	Chest Circumference	+	0.628	0.615
Coat Length	=	0.765	x	Coat Length	+	4.354	0.708
Crotch Height	=	1.066	x	Crotch Height, Left①	+	-1.180	0.800
Inside Sleeve Lgth, Right	=	0.901	x	Inside Sleeve Length, Right	+	2.493	0.643
Rise, NI	=	0.478	x	Rise	+	3.672	0.628
Shoulder Circumference	=	0.958	x	Overarm	+	0.711	0.814
Shoulder Slope, Right	=	0.642	x	Shoulder Slope, Right	+	0.501	0.386
Stature	=	0.913	x	Height (reported)	+	4.851	0.639
Waist Circ, NI	=	0.918	x	Coat Waist	+	1.025	0.700
Waist Circumference, O	=	1.154	x	Waist Circumference	+	-5.969	0.891
Waist Height, NI	=	1.090	x	Outseam, Left	+	-2.094	0.784
Waist Height, O	=	0.976	x	Back-Floor Height	+	0.067	0.766
Waist Height, O	=	1.003	x	Front-Floor Height	+	0.430	0.858
Waist Height, O	=	1.032	x	Outseam, Left	+	-2.173	0.711
Weight	=	1.005	x	Weight (reported)	+	-4.627	2.627

①Calculated dimensions.

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TABLE 9

Anthropological Dimension Prediction Equations: Females
(weight in pounds, all others in inches)

ANTHROPOLOGICAL DIMENSION	=	SLOPE	x	TAILORING DIMENSION	+	INTERCEPT	STANDARD ERROR
Bicep Circ, Flexed	=	0.889	x	Bicep Circ, Flexed	+	0.688	0.354
Bust Position	=	0.911	x	Bust Position	+	0.452	0.411
Buttock Circumference	=	0.991	x	Seat	+	-1.255	0.876
Chest Circumference	=	0.998	x	Bust Circumference	+	-1.274	0.865
Chest Circumference, Scye	=	0.955	x	Chest Circumference	+	0.787	0.988
Coat Length	=	0.873	x	Coat Length	+	1.691	0.532
Crotch Height	=	0.810	x	Crotch Height, Left①	+	5.753	0.957
Front Waist Length, NI	=	0.357	x	Front Waist Length	+	10.781	0.873
Inside Sleeve Lgth, Right	=	0.884	x	Inside Sleeve Length, Right	+	2.301	0.659
Interscye II	=	0.802	x	Point to Point	+	0.586	0.706
Rise, NI	=	0.020	x	Rise	+	7.286	0.714
Shoulder Slope, Right	=	0.370	x	Shoulder Slope, Right	+	0.818	0.240
Skirt Length, O	=	0.484	x	Skirt Length	+	8.886	0.975
Stature	=	0.895	x	Height (reported)	+	6.076	0.698
Waist Circumference, NI	=	0.854	x	Waist Circumference	+	2.642	1.210
Waist Circumference, O	=	1.061	x	Waist Circumference	+	-1.387	1.778
Waist Height, NI	=	0.947	x	Back-Floor Height	+	2.153	1.003
Waist Height, O	=	0.761	x	Front-Floor Height	+	7.946	1.124
Waist Height, O	=	0.802	x	Outseam, Left	+	5.091	1.095
Weight	=	0.928	x	Weight (reported)	+	10.471	5.457

①Calculated dimensions.

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TABLE 10

Tailoring Dimension Conversion Charts: Males

BACK-FLOOR HEIGHT
(values in inches)

Formula: Back-Floor Height *(tailoring)* = 0.921 x Waist Height, O *(anthropological)* + 4.200

Plot: Page 131

If Anthropological equals:	Then Tailoring Equals:
35	36.4
36	37.4
37	38.3
38	39.2
39	40.1
40	41.0
41	42.0
42	42.9
43	43.8
44	44.7
45	45.6
46	46.6
47	47.5

TABLE 11

Tailoring Dimension Conversion Charts: Males

CHEST CIRCUMFERENCE
(values in inches)

Formula: Chest Circ *(tailoring)* = 1.054 x Chest Circ *(anthropological)* + 1.068

Plot: Page 131

If Anthropological equals:	Then tailoring equals:
32	34.8
33	35.9
34	36.9
35	38.0
36	39.0
37	40.1
38	41.1
39	42.2
40	43.2
41	44.3
42	45.3
43	46.4
44	47.4
45	48.5
46	49.6
47	50.6
48	51.7

TABLE 12

Tailoring Dimension Conversion Charts: Males

COAT LENGTH
(values in inches)

Formula: Coat Length *(tailoring)* = 0.983 x Coat Length *(anthropological)* + 3.169

Plot: Page 132

If Anthropological equals:	Then tailoring equals:
23	25.8
24	26.8
25	27.7
26	28.7
27	29.7
28	30.7
29	31.7
30	32.7
31	33.6

TABLE 13

Tailoring Dimension Conversion Charts: Males

COAT WAIST
(values in inches)

Formula: Coat Waist *(tailoring)* = 1.035 x Waist Circ, NI *(anthropological)* + 0.618

Plot: Page 132

If anthropological equals:	Then tailoring equals:
26	27.5
27	28.6
28	29.6
29	30.6
30	31.7
31	32.7
32	33.7
33	34.8
34	35.8
35	36.8
36	37.9
37	38.9
38	39.9
39	41.0
40	42.0
41	43.1
42	44.1
43	45.1

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TABLE 14

Tailoring Dimension Conversion Charts: Males

CROTCH HEIGHT, LEFT
(values in inches)

Formula: Crotch Height, Left *(tailoring)* = 0.813 x Crotch Height *(anthropological)* + 5.179

Plot: Page 133

If anthropological equals:	Then Tailoring Equals:
27	27.1
28	27.9
29	28.8
30	29.6
31	30.4
32	31.2
33	32.0
34	32.8
35	33.6
36	34.4
37	35.3
38	36.1
39	36.9

TABLE 15

Tailoring Dimension Conversion Charts: Males

FRONT-FLOOR HEIGHT
(values in inches)

Formula: Front-Floor Height *(tailoring)* = 0.871 x Waist Height, O *(anthropological)* + 4.784

Plot: Page 133

If Anthropological equals:	Then Tailoring Equals:
35	35.3
36	36.1
37	37.1
38	38.1
39	39.1
40	40.1
41	41.1
42	42.1
43	43.1
44	44.1
45	45.1
46	46.1
47	47.1

TABLE 16

Tailoring Dimension Conversion Charts: Males

HEIGHT
(values in inches)

Formula: Height *(tailoring)* = 1.048 x Stature *(anthropological)* - 2.125

Plot: Page 134

If Anthropological equals:	Then Tailoring Equals:
61	61.8
62	62.9
63	63.9
64	64.9
65	66.0
66	67.0
67	68.1
68	69.1
69	70.2
70	71.2
71	72.3
72	73.3
73	74.4
74	75.4
75	76.5
76	77.5

TABLE 17

Tailoring Dimension Conversion Charts: Males

INSIDE SLEEVE LENGTH, LEFT
(values in inches)

Formula: Inside Slv Lgth, L *(tailoring)* = 0.833 x Inside Slv Lgth, R *(anthropological)* + 2.321

Plot: Page 134

If Anthropological equals:	Then Tailoring Equals:
16	15.6
17	16.5
18	17.3
19	18.1
20	19.0
21	19.8
22	20.6

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TABLE 18

Tailoring Dimension Conversion Charts: Males

INSIDE SLEEVE LENGTH, RIGHT
(values in inches)

Formula: Inside Slv Lgth, R *(tailoring)* = 0.833 x Inside Slv Lgth, R *(anthropological)* + 2.427

Plot: Page 135

If anthropological equals:	Then Tailoring Equals:
16	15.8
17	16.6
18	17.4
19	18.3
20	19.1
21	19.9
22	20.8

TABLE 19

Tailoring Dimension Conversion Charts: Males

OUTSEAM, LEFT
(values in inches)

Formula: Outseam, Left (tailoring) = 0.885 x Waist Height, O *(anthropological)* + 5.589

Plot: Page 135

If anthropological equals:	Then Tailoring Equals:
35	36.6
36	37.4
37	38.3
38	39.2
39	40.1
40	41.0
41	41.9
42	42.8
43	43.6
44	44.5
45	45.4
46	46.3
47	47.2

TABLE 20

Tailoring Dimension Conversion Charts: Males

OUTSEAM, RIGHT
(values in inches)

Formula: Outseam, Right (tailoring) = 0.876 x Waist Height, O *(anthropological)* + 6.011

Plot: Page 136

If anthropological equals:	Then Tailoring Equals:
35	36.7
36	37.5
37	38.4
38	39.3
39	40.2
40	41.1
41	41.9
42	42.8
43	43.7
44	44.6
45	45.4
46	46.3
47	47.2

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TABLE 21

Tailoring Dimension Conversion Charts: Males

OVERARM
(values in inches)

Formula: Overarm *(tailoring)* = 0.969 x Shoulder Circumference *(anthropological)* + 2.708

Plot: Page 136

If anthropological equals:	Then Tailoring Equals:
39	40.5
40	41.5
41	42.4
42	43.4
43	44.4
44	45.3
45	46.3
46	47.3
47	48.3
48	49.2
49	50.2
50	51.2
51	52.1
52	53.1
53	54.1
54	55.0
55	56.0
56	57.0
57	57.9

TABLE 22

Tailoring Dimension Conversion Charts: Males

RISE
(values in inches)

Formula: Rise *(tailoring)* = 0.458 x Rise, NI *(anthropological)* + 5.284

Plot: Page 137

If anthropological equals:	Then Tailoring Equals:
9	9.4
10	9.9
11	10.3
12	10.8
13	11.2
14	11.7

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TABLE 23

Tailoring Dimension Conversion Charts: Males

SEAT
(values in inches)

Formula: Seat *(tailoring)* = 0.988 x Buttock Circumference *(anthropological)* + 2.727

Plot: Page 137

If anthropological equals:	Then Tailoring Equals:
31	33.4
32	34.3
33	35.3
34	36.3
35	37.3
36	38.3
37	39.3
38	40.3
39	41.3
40	42.2
41	43.2
42	44.2
43	45.2
44	46.2
45	47.2
46	48.2
47	49.2
48	50.2

TABLE 24

Tailoring Dimension Conversion Charts: Males

SHOULDER SLOPE, LEFT
(values in inches)

Formula: Shoulder Slope, L *(tailoring)* = 0.441 x Shoulder Slope, R *(anthropological)* + 1.690

Plot: Page 138

If anthropological equals:	Then Tailoring Equals:
1	2.1
2	2.6
3	3.0
4	3.5

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TABLE 25

Tailoring Dimension Conversion Charts: Males

SHOULDER SLOPE, RIGHT
(values in inches)

Formula: Shoulder Slope, Rt *(tailoring)* = 0.644 x Shoulder Slope, Rt *(anthropological)* + 1.232

Plot: Page 138

If anthropological equals:	Then Tailoring Equals:
1	1.9
2	2.5
3	3.2
4	3.8

TABLE 26

Tailoring Dimension Conversion Charts: Males

WAIST CIRCUMFERENCE
(values in inches)

Formula: Waist Circ *(tailoring)* = 0.812 x Waist Circ, O *(anthropological)* + 6.980

Plot: Page 139

If anthropological equals:	Then Tailoring Equals:
27	28.9
28	29.7
29	30.5
30	31.3
31	32.2
32	33.0
33	33.8
34	34.6
35	35.4
36	36.2
37	37.0
38	37.8
39	38.6
40	39.5
41	40.3
42	41.1
43	41.9
44	42.7
45	43.5

TABLE 27

Tailoring Dimension Conversion Charts: Males

WEIGHT
(values in pounds)

Formula: Weight *(tailoring)* = 0.987 x Weight *(anthropological)* + 5.800

Plot: Page 139

If anthropological equals:	Then Tailoring Equals:
100	104.5
105	109.4
110	114,4
115	119.3
120	124.2
125	129.2
130	134.1
135	139.1
140	144.0
145	148.9
150	153.9
155	158.8
160	163.7
165	168.7
170	173.6
175	178.5
180	183.5
185	188.4
190	193.3
195	198.3
200	203.2
205	208.1
210	213.1
215	218.0
220	222.9
225	227.9
230	232.8
235	237.7
240	242.7
245	247.6
250	252.6
255	257.5
260	262.4
265	267.4
270	272.3

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TABLE 28

Tailoring Dimension Conversion Charts: Females

BACK-FLOOR HEIGHT
(values in inches)

Formula: Back-Floor Height *(tailoring)* = 0.812 x Waist Height, NI *(anthropological)* + 7.752

Plot: Page 140

If anthropological equals:	Then Tailoring Equals:
36	37.0
37	37.8
38	38.6
39	39.4
40	40.2
41	41.0
42	41.9
43	42.7
44	43.5
45	44.3
46	45.1
47	45.9

TABLE 29

Tailoring Dimension Conversion Charts: Females

BICEPS CIRCUMFERENCE, FLEXED
(values in inches)

Formula: Biceps Circ, Flxd *(tailoring)* = 0.956 x Biceps Circ, Flxd *(anthropological)* + 1.112

Plot: Page 140

If anthropological equals:	Then Tailoring Equals:
9	9.7
10	10.7
11	11.6
12	12.6
13	13.5
14	14.5

TABLE 30

Tailoring Dimension Conversion Charts: Females

BUST CIRCUMFERENCE
(values in inches)

Formula: Bust Circ *(tailoring)* = 0.892 x Chest Circ *(anthropological)* + 5.275

Plot: Page 141

If anthropological equals:	Then Tailoring Equals:
29	31.1
30	32.0
31	32.9
32	33.8
33	34.7
34	35.6
35	36.5
36	37.4
37	38.3
38	39.2
39	40.1
40	41.0
41	41.8
42	42.7
43	43.6
44	44.5
45	45.4

TABLE 31

Tailoring Dimension Conversion Charts: Females

BUST POSITION
(values in inches)

Formula: Bust Position *(tailoring)* = 0.909 x Bust Position *(anthropological)* + 2.002

Plot: Page 141

If Anthropological equals:	Then Tailoring Equals:
11	12.0
12	12.9
13	13.8
14	14.7
15	15.6
16	16.5

35

TABLE 32

Tailoring Dimension Conversion Charts: Females

CHEST CIRCUMFERENCE
(values in inches)

Formula: Chest Circ *(tailoring)* = 0.831 x Chest Circ *(anthropological)* + 6.915

Plot: Page 142

If anthropological equals:	Then Tailoring Equals:
29	31.0
30	31.8
31	32.7
32	33.5
33	34.3
34	35.2
35	36.0
36	36.8
37	37.7
38	38.5
39	39.3
40	40.2
41	41.0
42	41.8
43	42.6
44	43.5

TABLE 33

Tailoring Dimension Conversion Charts: Females

COAT LENGTH
(values in inches)

Formula: Coat Length *(tailoring)* = 0.867 x Coat Length *(anthropological)* + 5.215

Plot: Page 142

If anthropological equals:	Then Tailoring Equals:
23	25.2
24	26.0
25	26.9
26	27.8
27	28.6
28	29.5
29	30.4

36

TABLE 34

Tailoring Dimension Conversion Charts: Females

CROTCH HEIGHT, LEFT
(values in inches)

Formula: Crotch Height, Left *(tailoring)* = 0.870 x Crotch Height *(anthropological)* + 4.150

Plot: Page 143

If anthropological equals:	Then Tailoring Equals:
27	27.6
28	28.5
29	29.4
30	30.3
31	31.1
32	32.0
33	32.9
34	33.7
35	34.6
36	35.5

TABLE 35

Tailoring Dimension Conversion Charts: Females

FRONT-FLOOR HEIGHT
(values in inches)

Formula: Front-Floor Height *(tailoring)* = 0.817 x Waist Height, NI *(anthropological)* + 6.401

Plot: Page 143

If anthropological equals:	Then Tailoring Equals:
36	35.8
37	36.6
38	37.4
39	38.3
40	39.1
41	39.9
42	40.7
43	41.5
44	42.3
45	43.2
46	44.0
47	44.8

37

TABLE 36

Tailoring Dimension Conversion Charts: Females

FRONT WAIST LENGTH
(values in inches)

Formula: Front Waist Lgth *(tailoring)* = 0.745 x Front Waist Lgth, O *(anthropological)* + 5.880

Plot: Page 144

If anthropological equals:	Then Tailoring Equals:
19	20.0
20	20.8
21	21.5
22	22.3
23	23.0
24	23.8

TABLE 37

Tailoring Dimension Conversion Charts: Females

HEIGHT
(values in inches)

Formula: Height *(tailoring)* = 1.011 x Stature *(anthropological)* - 0.006

Plot: Page 144

If anthropological equals:	Then Tailoring Equals:
59	59.6
60	60.7
61	61.7
62	62.7
63	63.7
64	64.7
65	65.7
66	66.7
67	67.7
68	68.7
69	69.8
70	70.8

TABLE 38

Tailoring Dimension Conversion Charts: Females

INSIDE SLEEVE LENGTH, LEFT
(values in inches)

Formula: Inside Slv Lgth, L *(tailoring)* = 0.786 x Inside Slv Lgth, R *(anthropological)* + 3.338

Plot: Page 145

If anthropological equals:	Then Tailoring Equals:
15	15.1
16	15.9
17	16.7
18	17.5
19	18.3
20	19.1
21	19.8

TABLE 39

Tailoring Dimension Conversion Charts: Females

INSIDE SLEEVE LENGTH, RIGHT
(values in inches)

Formula: Inside Slv Lgth, R *(tailoring)* = 0.793 x Inside Slv Lgth, R *(anthropological)* + 3.328

Plot: Page 145

If anthropological equals:	Then Tailoring Equals:
15	15.2
16	16.0
17	16.8
18	17.6
19	18.4
20	19.2
21	20.0

39

TABLE 40

Tailoring Dimension Conversion Charts: Females

OUTSEAM, LEFT
(values in inches)

Formula: Outseam, Left (tailoring) = 0.792 x Waist Height, NI *(anthropological)* + 8.902

Plot: Page 146

If anthropological equals:	Then Tailoring Equals:
36	37.4
37	38.2
38	39.0
39	39.8
40	40.6
41	41.4
42	42.2
43	43.0
44	43.8
45	44.5
46	45.3
47	46.1

TABLE 41

Tailoring Dimension Conversion Charts: Females

OUTSEAM, RIGHT
(values in inches)

Formula: Outseam, Right (tailoring) = 0.786 x Waist Height, NI *(anthropological)* + 9.286

Plot: Page 146

If anthropological equals:	Then Tailoring Equals:
36	37.6
37	38.4
38	39.2
39	39.9
40	40.7
41	41.5
42	42.3
43	43.1
44	43.9
45	44.7
46	45.4
47	46.2

TABLE 42

Tailoring Dimension Conversion Charts: Females

POINT TO POINT
(values in inches)

Formula: Point to Point *(tailoring)* = 0.516 x Interscye II *(anthropological)* + 10.168

Plot: Page 147

If anthropological equals:	Then Tailoring Equals:
12	16.4
13	16.9
14	17.4
15	17.9
16	18.4
17	18.9

TABLE 43

Tailoring Dimension Conversion Charts: Females

RISE
(values in inches)

Formula: Rise *(tailoring)* = 0.112 x Rise, NI *(anthropological)* + 9.309

Plot: Page 147

If anthropological equals:	Then Tailoring Equals:
8	10.2
9	10.3
10	10.4
11	10.5
12	10.7
13	10.8

TABLE 44

Tailoring Dimension Conversion Charts: Females

SEAT
(values in inches)

Formula: Seat *(tailoring)* = 0.860 x Buttock Circumference *(anthropological)* + 6.970

Plot: Page 148

If anthropological equals:	Then Tailoring Equals:
33	35.4
34	36.2
35	37.1
36	37.9
37	38.8
38	39.7
39	40.5
40	41.4
41	42.2
42	43.1
43	44.0
44	44.8
45	45.7

TABLE 45

Tailoring Dimension Conversion Charts: Females

SHOULDER SLOPE, LEFT
(values in inches)

Formula: Shoulder Slope, Lt *(tailoring)* = 0.558 x Shoulder Slope, Lt *(anthropological)* + 1.512

Plot: Page 148

If anthropological equals:	Then Tailoring Equals:
0.5	1.8
1	2.1
2	2.6
3	3.2

42

TABLE 46

Tailoring Dimension Conversion Charts: Females

SHOULDER SLOPE, RIGHT
(values in inches)

Formula: Shoulder Slope, Rt *(tailoring)* = 0.719 x Shoulder Slope, Rt *(anthropological)* + 1.222

Plot: Page 149

If anthropological equals:	Then Tailoring Equals:
0.5	1.6
1	1.9
2	2.7
3	3.4

TABLE 47

Tailoring Dimension Conversion Charts: Females

SKIRT LENGTH
(values in inches)

Formula: Skirth Length *(tailoring)* = 0.542 x Skirt Length, NI *(anthropological)* + 11.496

Plot: Page 149

If anthropological equals:	Then Tailoring Equals:
20	22.3
21	22.9
22	23.4
23	24.0
24	24.5
25	25.0
26	25.6
27	26.1

43

TABLE 48

Tailoring Dimension Conversion Charts: Females

WAIST CIRCUMFERENCE
(values in inches)

Formula: Waist Circ *(tailoring)* = 0.884 x Waist Circ, NI *(anthropological)* + 5.225

Plot: Page 150

If anthropological equals:	Then Tailoring Equals:
24	26.4
25	27.3
26	28.2
27	29.1
28	30.0
29	30.9
30	31.7
31	32.6
32	33.5
33	34.4
34	35.3
35	36.2
36	37.0
37	37.9

44

TABLE 49

Tailoring Dimension Conversion Charts: Females

WEIGHT
(values in pounds)

Formula: Weight *(tailoring)* = 0.985 x Weight *(anthropological)* + 1.399

Plot: Page 150

If anthropological equals:	Then Tailoring Equals:
100	99.9
105	104.8
110	109.7
115	114.7
120	119.6
125	124.5
130	129.4
135	134.4
140	139.3
145	144.2
150	149.1
155	154.1
160	159.0
165	163.9
170	168.8
175	173.8
180	178.7
185	183.6
190	188.5
195	193.5
200	198.4

TABLE 50

Anthropological Dimension Conversion Charts: Males

BUTTOCK CIRCUMFERENCE
(values in inches)

Formula: Buttock Circumference *(anthropological)* = 0.956 x Seat *(tailoring)* - 0.516

Plot: Page 124

If tailoring equals:	Then Anthropological Equals:
35	32.9
36	33.9
37	34.9
38	35.8
39	36.8
40	37.7
41	38.7
42	39.6
43	40.6
44	41.5
45	42.5
46	43.5
47	44.4
48	45.4
49	46.3
50	47.3
51	48.2
52	49.2

46

TABLE 51

Anthropological Dimension Conversion Charts: Males

CHEST CIRCUMFERENCE
(values in inches)

Formula: Chest Circ *(anthropological)* = 0.909 x Chest Circ *(tailoring)* + 0.628

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
35	32.4
36	33.4
37	34.3
38	35.2
39	36.1
40	37.0
41	37.9
42	38.8
43	39.7
44	40.6
45	41.5
46	42.4
47	43.4
48	44.3
49	45.2
50	46.1
51	47.0
52	47.9

TABLE 52

Anthropological Dimension Conversion Charts: Males

COAT LENGTH
(values in inches)

Formula: Coat Length *(anthropological)* = 0.765 x Coat Length *(tailoring)* + 4.354

Plot: Page 124

If Tailoring equals:	Then anthropological equals:
27	25.0
28	25.8
29	26.5
30	27.3
31	28.1
32	28.8
33	29.6
34	30.4

TABLE 53

Anthropological Dimension Conversion Charts: Males

CROTCH HEIGHT
(values in inches)

Formula: Crotch Height *(anthropological)* = 1.066 x Crotch Height, Left *(tailoring)* - 1.180

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
27	27.6
28	28.7
29	29.7
30	30.8
31	31.9
32	32.9
33	34.0
34	35.1
35	36.1
36	37.2
37	38.3

TABLE 54

Anthropological Dimension Conversion Charts: Males

INSIDE SLEEVE LENGTH, RIGHT
(values in inches)

Formula: Inside Slv Lgth, R *(anthropological)* = 0.901 x Inside Slv Lgth, R *(tailoring)* + 2.493

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
15	16.0
16	16.9
17	17.8
18	18.7
19	19.6
20	20.5
21	21.4

TABLE 55

Anthropological Dimension Conversion Charts: Males

RISE, NI
(values in inches)

Formula: Rise, NI *(anthropological)* = 0.478 x Rise *(tailoring)* + 3.672

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
8	7.5
9	8.0
10	8.5
11	8.9
12	9.4

TABLE 56

Anthropological Dimension Conversion Charts: Males

SHOULDER CIRCUMFERENCE
(values in inches)

Formula: Shoulder Circ *(anthropological)* = 0.958 x Overarm *(tailoring)* + 0.711

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
41	40.0
42	40.9
43	41.9
44	42.9
45	43.8
46	44.8
47	45.7
48	46.7
49	47.7
50	48.6
51	49.6
52	50.5
53	51.5
54	52.4
55	53.4
56	54.4
57	55.3

TABLE 57

Anthropological Dimension Conversion Charts: Males

SHOULDER SLOPE, RIGHT
(values in inches)

Formula: Shoulder Slope, R *(anthropological)* = 0.642 x Shoulder Slope R *(tailoring)* + 0.501

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
1	1.1
2	1.8
3	2.4
4	3.1

TABLE 58

Anthropological Dimension Conversion Charts: Males

STATURE
(values in inches)

Formula: Stature *(anthropological)* = 0.913 x Height *(tailoring)* + 4.851

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
63	62.4
64	63.3
65	64.2
66	65.1
67	66.0
68	66.9
69	67.8
70	68.8
71	69.7
72	70.6
73	71.5
74	72.4
75	73.3
76	74.2
77	75.2
78	76.1

TABLE 59

Anthropological Dimension Conversion Charts: Males

WAIST CIRCUMFERENCE, NI
(values in inches)

Formula: Waist Circ, NI *(anthropological)* = 0.918 x Coat Waist *(tailoring)* + 1.025

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
28	26.7
29	27.6
30	28.6
31	29.5
32	30.4
33	31.3
34	32.2
35	33.2
36	34.1
37	35.0
38	35.9
39	36.8
40	37.7
41	38.7
42	39.6
43	40.5
44	41.4
45	42.3

TABLE 60

Anthropological Dimension Conversion Charts: Males

WAIST CIRCUMFERENCE, O
(values in inches)

Formula: Waist Circ, O *(anthropological)* = 1.154 x Waist Circ *(tailoring)* - 5.969

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
28	26.3
29	27.5
30	28.7
31	29.8
32	31.0
33	32.1
34	33.3
35	34.4
36	35.6
37	36.7
38	37.9
39	39.0
40	40.2
41	41.3
42	42.5
43	43.7

TABLE 61

Anthropological Dimension Conversion Charts: Males

WAIST HEIGHT, NI
(values in inches)

Formula: Waist Height, NI *(anthropological)* = 1.090 x Outseam, Left *(tailoring)* - 2.094

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
36	37.1
37	38.2
38	39.3
39	40.4
40	41.5
41	42.6
42	43.7
43	44.8
44	45.9
45	47.0
46	48.0
47	49.1
48	50.2

TABLE 62

Anthropological Dimension Conversion Charts: Males

WAIST HEIGHT, O *(using Back-Floor Height)*
(values in inches)

Formula: Waist Height, O *(anthropological)* = 0.976 x Back-Floor Height *(tailoring)* + 0.067

Plot: Page 124

If Tailoring equals:	Then Anthropological equals:
36	35.2
37	36.2
38	37.2
39	38.1
40	39.1
41	40.1
42	41.1
43	42.0
44	43.0
45	44.0
46	45.0
47	45.9
48	46.9
49	47.9

TABLE 63

Anthropological Dimension Conversion Charts: Males

WAIST HEIGHT, O *(using Front-Floor Height)*
(values in inches)

Formula: Waist Height, O *(anthropological)* = 1.003 x Front-Floor Height *(tailoring)* + 0.430

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
35	35.5
36	36.5
37	37.5
38	38.5
39	39.5
40	40.6
41	41.6
42	42.6
43	43.6
44	44.6
45	45.6
46	46.6

TABLE 64

Anthropological Dimension Conversion Charts: Males

WAIST HEIGHT, O *(using Outseam, Left)*
(values in inches)

Formula: Waist Height, O *(anthropological)* = 1.032 x Outseam, Left *(tailoring)* - 2.173

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
36	35.0
37	36.0
38	37.0
39	38.1
40	39.1
41	40.1
42	41.2
43	42.2
44	43.2
45	44.3
46	45.3
47	46.3
48	47.4

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TABLE 65

Anthropological Dimension Conversion Charts: Males

WEIGHT
(values in pounds)

Formula: Weight *(anthropological)* = 1.005 x Weight *(tailoring)* - 4.627

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
110	105.9
115	110.9
120	116.0
125	121.0
130	126.0
135	131.0
140	136.1
145	141.1
150	146.1
155	151.1
160	156.2
165	161.2
170	166.2
175	171.2
180	176.3
185	181.3
190	186.3
195	191.3
200	196.4
205	201.4
210	206.4
215	211.4
220	216.5
225	221.5
230	226.5
235	231.5
240	236.6
245	241.6
250	246.6
255	251.6
260	256.7
265	261.7
270	266.7

TABLE 66

Anthropological Dimension Conversion Charts: Females

BICEPS CIRCUMFERENCE, FLEXED
(values in inches)

Formula: Biceps Circ, Flxd *(anthropological)* = 0.889 x Biceps Circ, Flxd *(tailoring)* + 0.688

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
10	9.6
11	10.5
12	11.4
13	12.2
14	13.1

TABLE 67

Anthropological Dimension Conversion Charts: Females

BUST POSITION
(values in inches)

Formula: Bust Position *(anthropological)* = 0.911 x Bust Position *(tailoring)* + 0.452

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
12	11.4
13	12.3
14	13.2
15	14.1
16	15.0
17	15.9

TABLE 68

Anthropological Dimension Conversion Charts: Females

BUTTOCK CIRCUMFERENCE
(values in inches)

Formula: Buttock Circumference *(anthropological)* = 0.991 x Seat *(tailoring)* - 1.255

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
35	33.4
36	34.4
37	35.4
38	36.4
39	37.4
40	38.4
41	39.4
42	40.4
43	41.4
44	42.3
45	43.3

TABLE 69

Anthropological Dimension Conversion Charts: Females

CHEST CIRCUMFERENCE
(values in inches)

Formula: Chest Circ *(anthropological)* = 0.998 x Bust Circ *(tailoring)* - 1.274

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
31	29.7
32	30.7
33	31.7
34	32.7
35	33.7
36	34.7
37	35.7
38	36.7
39	37.6
40	38.6
41	39.6
42	40.6
43	41.6
44	42.6
45	43.6

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TABLE 70

Anthropological Dimension Conversion Charts: Females

CHEST CIRCUMFERENCE, SCYE
(values in inches)

Formula: Chest Circumference, Scye *(anthropological)* = 0.955 x Chest Circ *(tailoring)* + 0.787

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
32	31.3
33	32.3
34	33.3
35	34.2
36	35.2
37	36.1
38	37.1
39	38.0
40	39.0
41	39.9
42	40.9
43	41.9

TABLE 71

Anthropological Dimension Conversion Charts: Females

COAT LENGTH
(values in inches)

Formula: Coat Length *(anthropological)* = 0.873 x Coat Length *(tailoring)* + 1.691

Plot: Page 124

If tailoring equals:	Then Anthropological Equals:
25	23.5
26	24.4
27	25.3
28	26.1
29	27.0
30	27.9

TABLE 72

Anthropological Dimension Conversion Charts: Females

CROTCH HEIGHT
(values in inches)

Formula: Crotch Height *(anthropological)* = 0.810 x Crotch Height, Left *(tailoring)* + 5.753

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
25	26.0
26	26.8
27	27.6
28	28.4
29	29.2
30	30.1
31	30.9
32	31.7
33	32.5
34	33.3
35	34.1

TABLE 73

Anthropological Dimension Conversion Charts: Females

FRONT WAIST LENGTH, NI
(values in inches)

Formula: Front Waist Length, NI *(anthropological)* = 0.357 x Front Waist Length *(tailoring)* + 10.781

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
19	17.6
20	17.9
21	18.3
22	18.6
23	19.0
24	19.3
25	19.7

TABLE 74

Anthropological Dimension Conversion Charts: Females

INSIDE SLEEVE LENGTH, RIGHT
(values in inches)

Formula: Inside Sleeve Lgth, R *(anthropological)* = 0.884 x Inside Sleeve Lgth, R *(tailoring)* + 2.301

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
14	14.7
15	15.6
16	16.4
17	17.3
18	18.2
19	19.1
20	20.0

TABLE 75

Anthropological Dimension Conversion Charts: Females

INTERSCYE II
(values in inches)

Formula: Interscye II *(anthropological)* = 0.802 x Point to Point *(tailoring)* + 0.586

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
16	13.4
17	14.2
18	15.0
19	15.8
20	16.6

TABLE 76

Anthropological Dimension Conversion Charts: Females

RISE, NI
(values in inches)

Formula: Rise, NI *(anthropological)* = 0.020 x Rise *(tailoring)* + 7.286

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
9	7.5
10	7.5
11	7.5
12	7.5

TABLE 77

Anthropological Dimension Conversion Charts: Females

SHOULDER SLOPE, RIGHT
(values in inches)

Formula: Shoulder Slope, R *(anthropological)* = 0.370 x Shoulder Slope, R *(tailoring)* + 0.818

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
1	1.2
2	1.6
3	1.9
4	2.3

TABLE 78

Anthropological Dimension Conversion Charts: Females

SKIRT LENGTH, O
(values in inches)

Formula: Skirt Length, O *(anthropological)* = 0.484 x Skirt Length *(tailoring)* + 8.886

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
21	19.1
22	19.5
23	20.0
24	20.5
25	21.0
26	21.5
27	22.0

TABLE 79

Anthropological Dimension Conversion Charts: Females

STATURE
(values in inches)

Formula: Stature *(anthropological)* = 0.895 x Height *(tailoring)* + 6.076

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
60	59.8
61	60.7
62	61.6
63	62.5
64	63.4
65	64.3
66	65.1
67	66.0
68	66.9
69	67.8
70	68.7
71	69.6

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TABLE 80

Anthropological Dimension Conversion Charts: Females

WAIST CIRCUMFERENCE, NI
(values in inches)

Formula: Waist Circ, NI *(anthropological)* = 0.854 x Waist Circ *(tailoring)* + 2.642

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
25	24.0
26	24.8
27	25.7
28	26.6
29	27.4
30	28.3
31	29.1
32	30.0
33	30.8
34	31.7
35	32.5
36	33.4
37	34.2
38	35.1

TABLE 81

Anthropological Dimension Conversion Charts: Females

WAIST CIRCUMFERENCE, O
(values in inches)

Formula: Waist Circ, O *(anthropological)* = 1.061 x Waist Circ *(tailoring)* - 1.387

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
25	25.1
26	26.2
27	27.3
28	28.3
29	29.4
30	30.4
31	31.5
32	32.6
33	33.6
34	34.7
35	35.7
36	36.8
37	37.9
38	38.9

TABLE 82

Anthropological Dimension Conversion Charts: Females

WAIST HEIGHT, NI
(values in inches)

Formula: Waist Height, NI *(anthropological)* = 0.947 x Back-Floor Height *(tailoring)* + 2.153

Plot: Page 124

If Tailoring equals:	Then Anthropological equals:
35	35.3
36	36.2
37	37.2
38	38.1
39	39.1
40	40.0
41	41.0
42	41.9
43	42.9
44	43.8
45	44.8
46	45.7

TABLE 83

Anthropological Dimension Conversion Charts: Females

WAIST HEIGHT, O *(using Front-Floor Height)*
(values in inches)

Formula: Waist Height, O *(anthropological)* = 0.761 x Front-Floor Height *(tailoring)* + 7.946

Plot: Page 124

If Tailoring equals:	Then Anthropological equals:
33	33.1
34	33.8
35	34.6
36	35.3
37	36.1
38	36.9
39	37.6
40	38.4
41	39.1
42	39.9
43	40.7
44	41.4

TABLE 84

Anthropological Dimension Conversion Charts: Females

WAIST HEIGHT, O *(using Outseam, Left)*
(values in inches)

Formula: Waist Height, O *(anthropological)* = 0.802 x Outseam, Left *(tailoring)* + 5.091

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
35	33.2
36	34.0
37	34.8
38	35.6
39	36.4
40	37.2
41	38.0
42	38.8
43	39.6
44	40.4
45	41.2

TABLE 85

Anthropological Dimension Conversion Charts: Females

WEIGHT
(values in pounds)

Formula: Weight *(anthropological)* = 0.928 x Weight *(tailoring)* + 10.471

Plot: Page 124

If tailoring equals:	Then Anthropological equals:
105	107.9
110	112.6
115	117.2
120	121.8
125	126.5
130	131.1
135	135.8
140	140.4
145	145.0
150	149.7
155	154.3
160	159.0
165	163.6
170	168.2
175	172.9
180	177.5
185	182.2
190	186.8
195	191.4
200	196.1
205	200.7

CONCLUSION

The recognition of differences between anthropological and tailoring measurements dates at least to 1953, when the U.S. Army's Quartermaster Corps (the predecessor to today's Natick Research, Development, and Engineering Center), undertook a small study to document differences and identify conversions between the two techniques (Newman and Winston, 1953). At that time, using 42 male subjects and 10 dimensions, the authors demonstrated that the tailoring measures were generally larger, due in part to clothing, and in part to technique.

The present study expands on that work, using 16 measures and a larger sample of both men and women. The overall results confirm Newman and Winston's work, although the specific amounts of differences between the two approaches varies for many dimensions. For example, the mean difference for chest in the earlier study was 2.0 inches, while in our study it is 3.1 inches. Some of the difference between the two studies may be due to the difference in sample size, but most is likely due to differences in the measurement techniques. As techniques change over time, it is useful to revisit the issue of anthropological/tailoring differences, and update the conversions between the two approaches.

The tables shown in this report will enable the user to take measurements from one approach, whether from an individual or from a group of individuals (mean, etc.), and predict what those measurements would be when taken using the alternative method. This is not an exact transformation, because any measurement of a human is not an exact measurement. However, for most purposes, and especially for a clothing application, the conversions should be sufficiently accurate to be useful.

After this research was begun, we became concerned that there might be significant differences in measuring technique *among* tailors. This could confound the results. To identify whether these concerns were valid, we conducted a small experiment with one subject and three experienced measurers from the tailoring tradition. One of these was from Haas and of the other two, one was military, and one was civilian. Using a series of 7 dimensions (plus 3 others for two of the measurers), we found that two of the measurers got the same value for chest and total sleeve length. The third measurer differed by 4 ¼ inches on chest. The greatest differences were found in back length (5 ¼ inches), trouser inseam and shoulder circumference (3 inches each). It seemed clear that the various measurers were using different measuring points in those cases. Even where measuring points were the same, however, (e.g., shoulder circumference and chest) the differences were as large as 4¼ inches. From this we can suppose that differences among tailors may be a significant factor, and should be considered in future research on differences between anthropometric and tailoring measurements.

The direction of the next phase of this research will be to apply the conversions created here to the Army's existing ANSUR database. This will allow Army tailors direct access to measurements with which they are familiar. After converting the appropriate dimensions, we will also review the sizing systems of current Army dress garments, and make recommended changes where necessary to accommodate the converted dimensions.

REFERENCES

Clauser, Charles E., John T. McConville, Claire C. Gordon, and Ilse O. Tebbetts, 1986, *Selection of Dimensions for an Anthropometric Data Base Volume I: Rationale, Summary, and Conclusions,* Technical Report NATICK/TR-86/053 (AD A179 566), US Army Natick Research, Development and Engineering Center, Natick, Massachusetts.

Clauser, Charles, Ilse Tebbetts, Bruce Bradtmiller, John McConville and Claire Gordon, 1988, *Measurer's Handbook: U.S. Army Anthropometric Survey, 1987-1988,* Technical Report NATICK/TR-88-043 (AD A164 637), U.S. Army Natick Research, Development and Engineering Center, Natick, Massachusetts.

Gordon, Claire C., Bruce Bradtmiller, Charles E. Clauser, Thomas Churchill, John T. McConville, Ilse Tebbetts and Robert A. Walker, 1989, *1987-1988 Anthropometric Survey of U.S. Army Personnel: Methods and Summary Statistics,* Technical Report NATICK/TR-89-044, U.S. Army Natick Research, Development and Engineering Center, Natick, Massachusetts.

Newman, Russell W. and Gerald Winston 1953 *Comparison of Ten Anthropometric and Tailoring Measures on the Same Men,* Report No. 210, Environmental Protection Branch, Quartermaster Climatic Research Laboratory, Lawrence, MA.

APPENDIX A

ANTHROPOLOGICAL MEASUREMENT AND LANDMARK DESCRIPTIONS

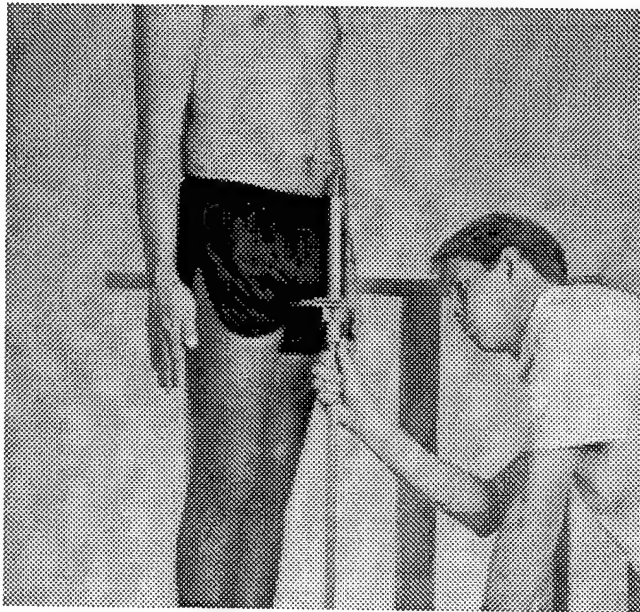ANTHROPOLOGICAL MEASUREMENT DESCRIPTIONS

ACROMIAL HEIGHT

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **acromion, right.**

<u>PROCEDURE</u>:   Subject is in the anthropometric standing position. Stand to the right of the subject, and use an anthropometer to measure the vertical distance between the standing surface and the drawn **acromion landmark** on the tip of the right shoulder. The measurement is made at the maximum point of quiet respiration.

<u>CAUTION</u>:   The subject must not be allowed to change the position of the shoulders.
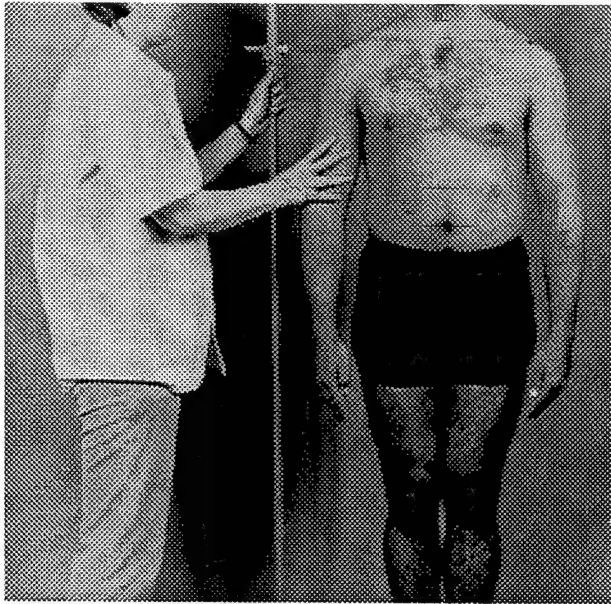
AXILLA HEIGHT

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **anterior scye on the torso, right.**

<u>PROCEDURE</u>:   Subject is in the anthropometric standing position. Stand in front of the subject and use an anthropometer to measure the vertical distance between the standing surface and the axillary fold as designated by the drawn **anterior-scye-on-the-torso landmark.** The measurement is taken at the maximum point of quiet respiration.

<u>CAUTION</u>:   The subject must not be allowed to change the position of the shoulders.
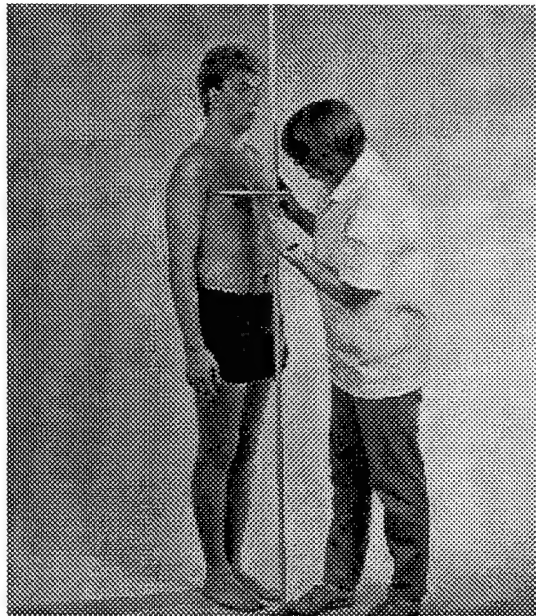
LANDMARK(S) ENCOMPASSED: **Biceps point.**

PROCEDURE: Subject stands. The right upper arm is extended forward horizontally and the elbow is flexed about 90 degrees. Place a tape around the upper arm at the level of the drawn **biceps point landmark.** The fist is clenched and held facing the head. The subject is urged to exert maximum effort in "making a muscle." Stand at the right of the subject and use a tape to measure the circumference of the upper arm. The tape should be in a plane perpendicular to the long axis of the upper arm. Exert only enough tension on the tape to maintain contact between the tape and the skin.
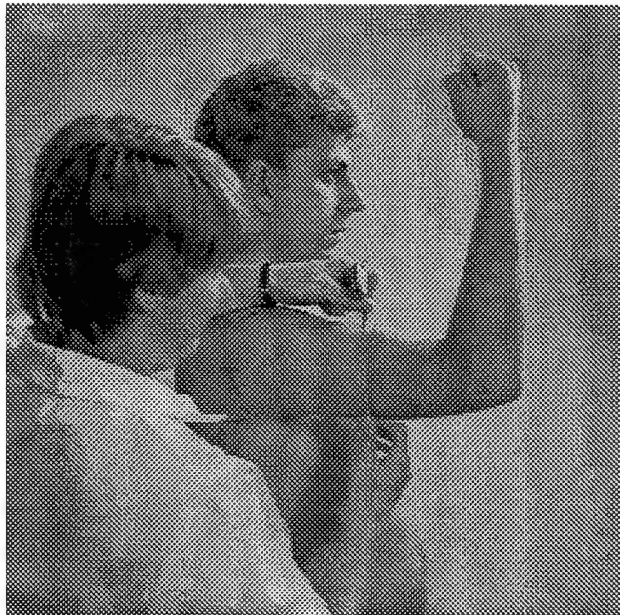
LANDMARK(S) ENCOMPASSED: **Buttock point: right lateral, left lateral, and posterior.**

PROCEDURE: Subject stands erect on a table with heels together. Ask the subject to hold up the right leg of the shorts to expose the landmark. Stand at the subject's right and use a tape to measure the horizontal circumference of the trunk at the level of the maximum protrusion of the right buttock. The tape should pass over the **posterior buttock point** (not drawn) and the **buttock point landmarks** drawn on the right and left hips. (On the right hip this landmark is a horizontal line with a "B" drawn beside it.) If necessary, ask male subjects to adjust the genitalia so as to interfere as little as possible with the tape. Exert only enough tension on the tape to maintain contact between the tape and the skin.

CAUTION: The tape must be maintained in a horizontal plane.
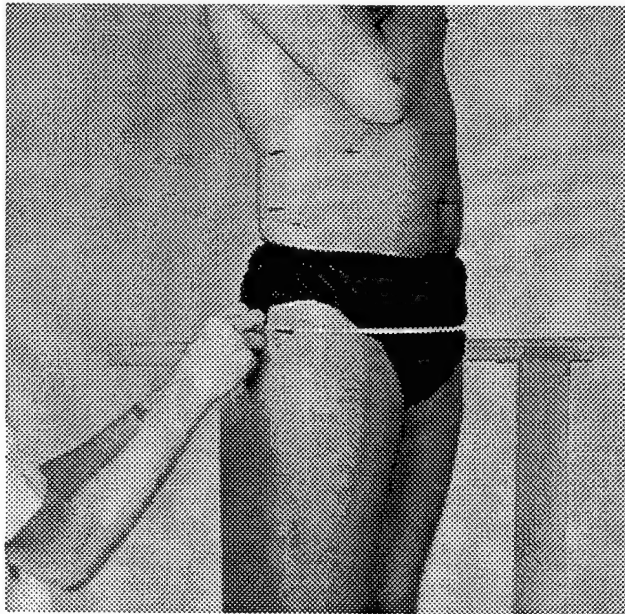
CERVICALE HEIGHT

ORIGIN-TERMINATION: Standing surface -- **cervicale.**

PROCEDURE: Subject is in the anthropometric standing position with the head held in the Frankfort plane. Stand behind the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn **cervicale landmark.** The measurement is taken at the maximum point of quiet respiration.

CAUTION: Be sure the subject's head remains in the Frankfort plane while the measurement is taken.
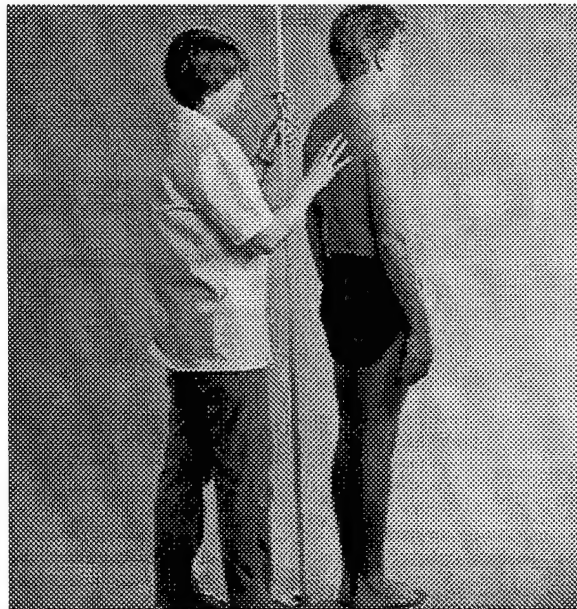
LANDMARK(S) ENCOMPASSED: **Bustpoint/thelion, right.**

PROCEDURE: Subject is in the anthropometric standing position in front of a mirror. Stand in front of the subject and use a tape to measure the horizontal circumference of the chest at the level of the bustpoint on women and the nipple on men **(bustpoint/thelion, right).** For women, the landmark is drawn on the bra. It is not drawn on male subjects. Use the mirror to check the position of the tape as it crosses the subject's back. This dimension will cross very soft tissue at the armpit and bust, and some compression of the tissue will inevitably occur. Be sure, however, to keep this to a minimum. Exert only enough tension on the tape to maintain contact between the tape and the skin. The tape will span body hollows in this measurement. The measurement is taken at the maximum point of quiet respiration.

CAUTION: This must be a horizontal measurement. It will not necessarily cross the **left bustpoint/thelion landmark.**
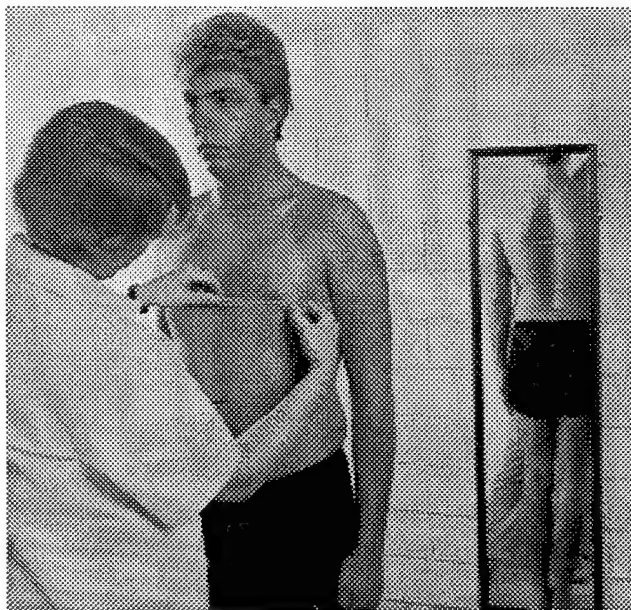
CHEST CIRCUMFERENCE AT SCYE

LANDMARK(S) ENCOMPASSED: **Scye at midspine.**

PROCEDURE: Subject stands erect looking straight ahead in front of a mirror. The heels are together and the weight is equally distributed on both feet. The subject puts both fists on the tops of the hips. Place a tape around the torso, passing over the drawn **scye level at midspine landmark.** Use the mirror to check the position of the tape as it crosses the subject's back. After the tape is in place, the subject drops the arms to the sides with the palms facing the thighs. Stand in front of the subject and use the tape to measure the horizontal circumference of the chest at the level of the landmark. This dimension will cross very soft tissue at the armpit and bust, and some compression of the tissue will inevitably occur. Be sure, however, to keep this to a minimum. Exert only enough tension on the tape to maintain contact between the tape and the skin. The tape will span body hollows in this measurement. The measurement is taken at the maximum point of quiet respiration.
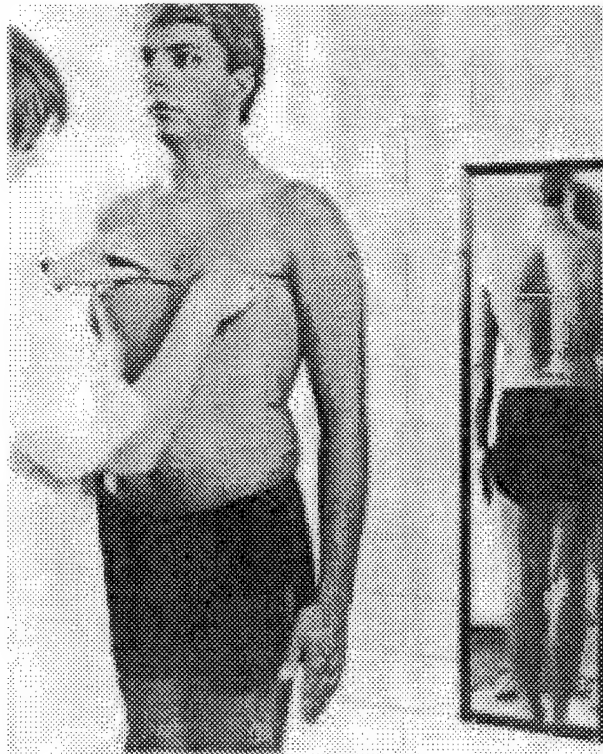
CHEST HEIGHT

ORIGIN-TERMINATION: Standing surface -- **bustpoint/thelion, right.**

PROCEDURE: Subject is in the anthropometric standing position. Stand in front of the subject and use an anthropometer to measure the vertical distance between the standing surface and the right bustpoint on women and the nipple on men **(bustpoint/thelion, right).** The landmark is drawn on the bra for female subjects; it is not drawn on men. The measurement is taken at the maximum point of quiet respiration.
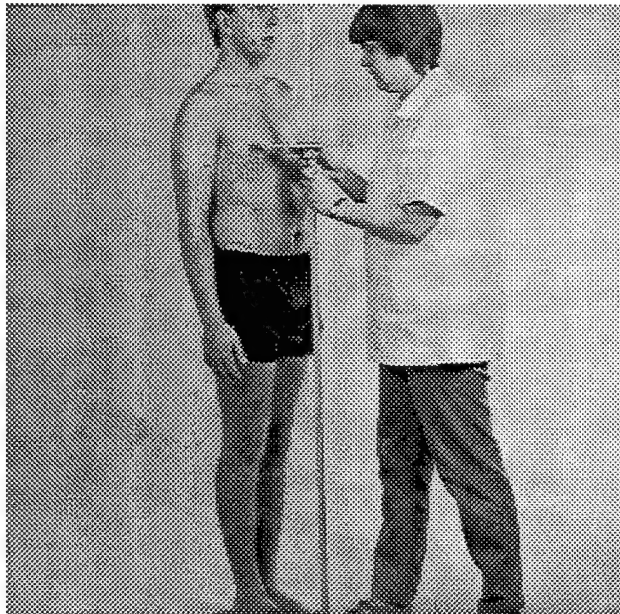
CROTCH HEIGHT

ORIGIN-TERMINATION: Standing surface -- **crotch.**

PROCEDURE: Subject stands on a table in the anthropometric standing position. Stand in front of the subject. The subject spreads the legs apart enough to allow placement of the blade of an anthropometer near the crotch. The subject then brings the heels back together and raises the blade until it is in firm contact with the crotch. (Place the blade to the right of the genitalia.) The measurer then exerts additional upward pressure on the slide of the anthropometer to achieve firm and uniform placement. Measure the vertical distance between the standing surface and the **crotch.**

CAUTION: The computer will add 1 cm to the recorded dimension to account for the width of the anthropometer blade.

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **gluteal furrow point.**

<u>PROCEDURE</u>:   Subject stands on a table in the anthropometric standing position. Ask the subject to hold up the right leg of the shorts to expose the landmark. Stand at the right of the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn landmark at the lowest point of the gluteal furrow under the buttocks.
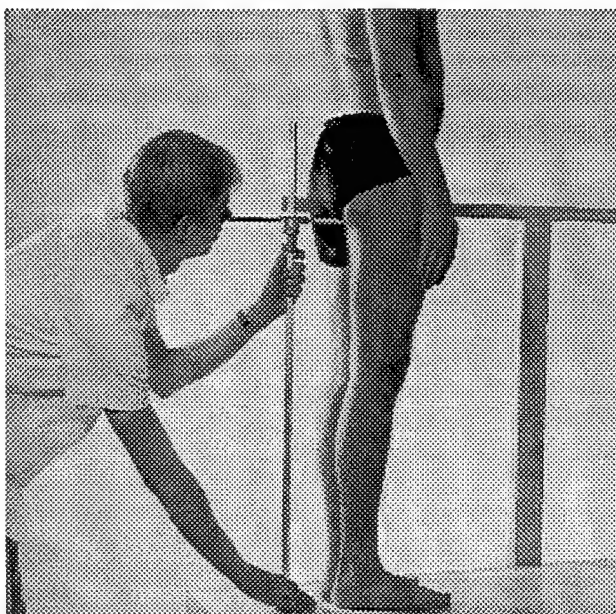
ORIGIN-TERMINATION: **Midscye, right -- midscye, left.**

PROCEDURE: Subject is in the anthropometric standing position. Stand behind the subject and use a tape to measure the distance between the drawn **right** and **left midscye landmarks.** The tape is held on the skin except where it spans the hollows of the back. Be sure the tape goes across the back in a straight line and does not arch up over the shoulder blades. The measurement is taken at the maximum point of quiet respiration.

CAUTION: The subject must not be allowed to change the position of the shoulders.
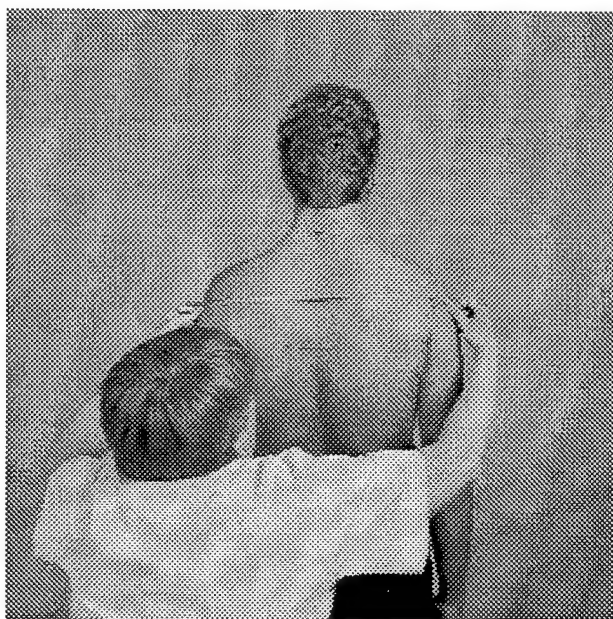
NECK HEIGHT, LATERAL

ORIGIN-TERMINATION: Standing surface -- **trapezius point, right.**

PROCEDURE: Subject is in the anthropometric standing position with the head in the Frankfort plane. Stand behind the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn **trapezius point** on the right side of the neck. The measurement is made at the maximum point of quiet respiration.

CAUTION: Be sure the head is in the Frankfort plane.
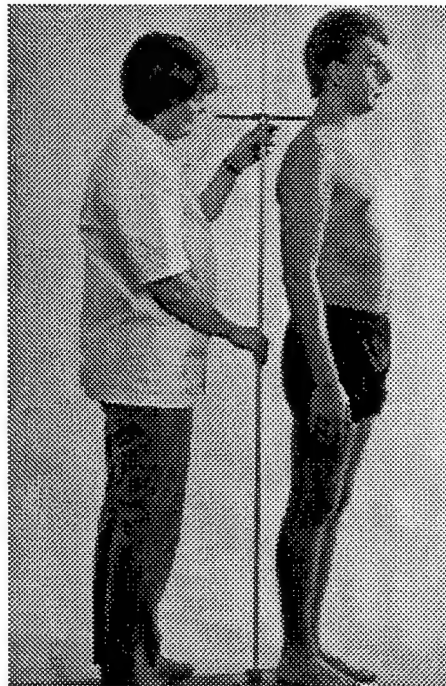
KNEE HEIGHT, MIDPATELLA

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **midpatella.**

<u>PROCEDURE</u>:   Subject stands erect on a table with the heels together and the weight distributed equally on both feet. Stand at the right of the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn **midpatella landmark** at the center of the knee.

<u>CAUTION</u>:   Subjects will tend to lock their knees. If subjects have difficulty keeping the knee loose, firmly grasp the thigh a few inches above the knee for a moment. This will induce relaxation of the patella which is necessary for this measurement.
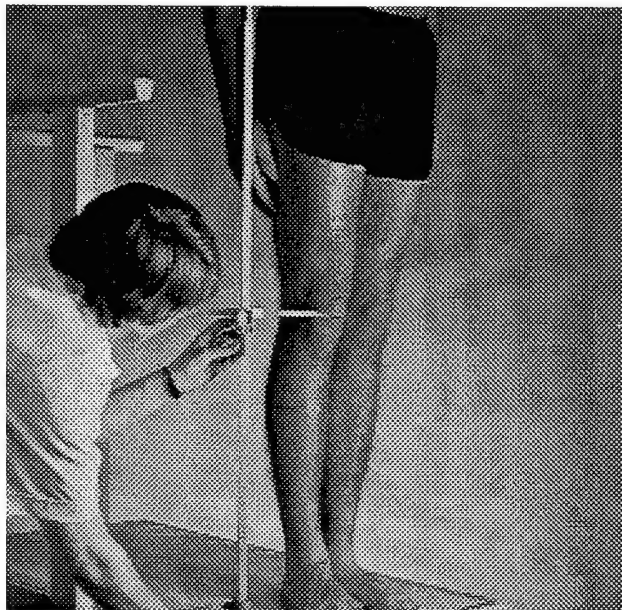
SHOULDER CIRCUMFERENCE

LANDMARK(S) ENCOMPASSED: **Deltoid point, right; deltoid point, left.**

PROCEDURE: Subject is in the anthropometric standing position in front of a mirror. Stand in front of the subject and use a tape to measure the horizontal circumference of the shoulders at the level of the maximum protrusion of the right deltoid muscle. Use the mirror to check the position of the tape as it crosses the subject's back. The tape will pass over the drawn **right** and **left deltoid point landmarks.** Exert only enough tension on the tape to maintain contact between the tape and the skin. The measurement is taken at the maximum point of quiet respiration.
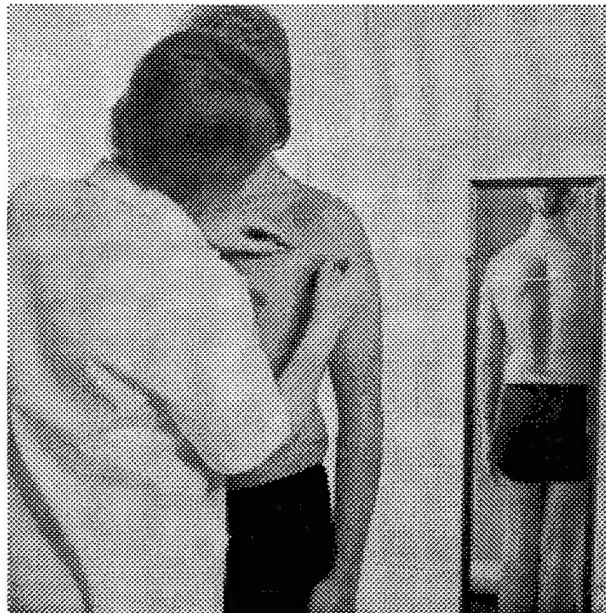
SHOULDER LENGTH

<u>ORIGIN-TERMINATION</u>: **Trapezius point, right – acromion, right.**

<u>PROCEDURE</u>: Subject is in the anthropometric standing position. Stand at the right of the subject and use a tape to measure the surface distance between the drawn **trapezius point landmark** at the base of the neck and the drawn **acromion landmark** on the outer border of the shoulder. The zero end of the tape is on the **trapezius point**, and the front (anterior) edge of the tape passes over the drawn **clavicle point landmark**.

<u>CAUTION</u>: The subject must not be allowed to change the position of the shoulders.
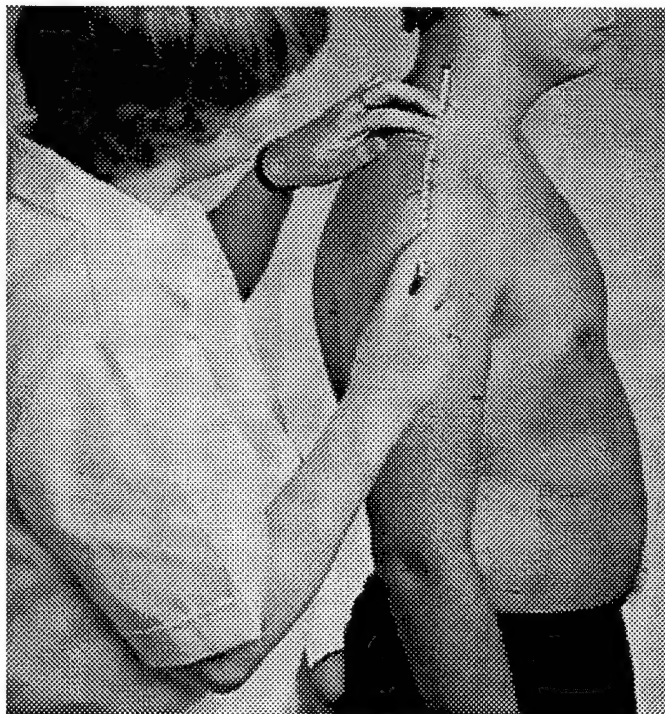
ORIGIN-TERMINATION: Standing surface -- **top of head.**

PROCEDURE: Subject is in the anthropometric standing position with the head in the Frankfort plane. Stand at one side of the subject and use an anthropometer to measure the vertical distance between the standing surface and the **top of the head.** Move the blade of the anthropometer across the top of the head to ensure measurement of the maximum distance. Use firm pressure to compress the subject's hair. The measurement is taken at the maximum point of quiet respiration.

CAUTION: Be sure that the head is in the Frankfort plane.
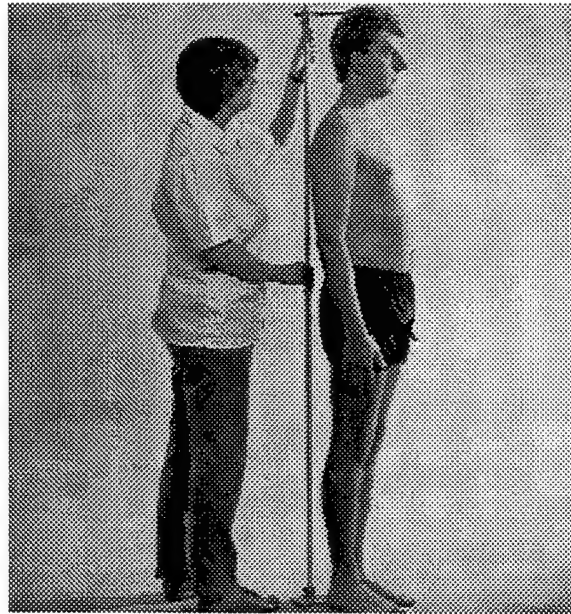
STRAP LENGTH

DESCRIPTION: The distance from **bustpoint/thelion, right,** across the back of the neck, to **bustpoint/thelion, left.**

PROCEDURE: Subject is in the anthropometric standing position with the head in the Frankfort plane. Stand in front of the subject and use a tape to measure the surface distance from the right bustpoint of women or nipple for men **(bustpoint/thelion)** over the back of the neck to the left bustpoint or nipple. The **bustpoint/thelion landmarks** are drawn on the bra for women; they are not drawn on male subjects. The tape should pass over the **right** and **left lateral neck landmarks.** Exert only enough tension to maintain contact between the tape and the skin (or bra). The tape will span body hollows. The measurement is made at the maximum point of quiet respiration.

CAUTION: Be sure that the zero point of the tape is on the **right bustpoint/thelion landmark** when the measurement is made. Be sure that the subject's head is in the Frankfort plane.
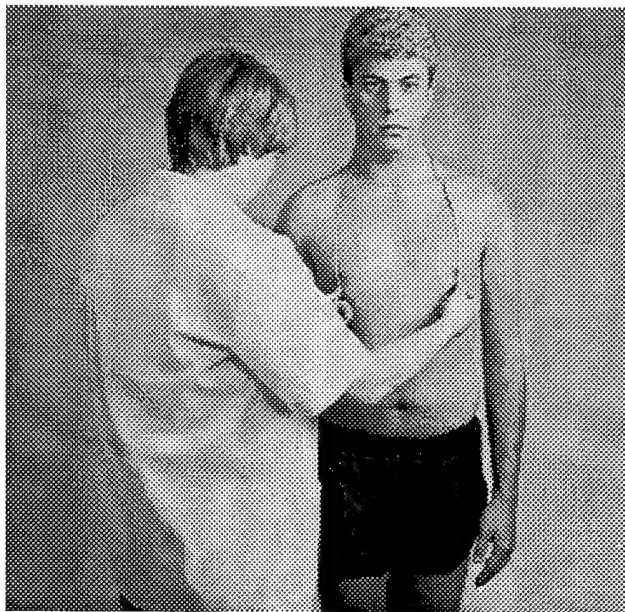
WAIST BACK LENGTH (NATURAL INDENTATION)

<u>ORIGIN-TERMINATION</u>:   **Cervicale – waist (natural indentation), posterior.**

<u>PROCEDURE</u>:   Subject is in the anthropometric standing position with the head in the Frankfort plane. Stand behind the subject and use a tape to measure the vertical surface distance between the drawn landmarks at **cervicale** and **posterior waist (natural indentation).** The tape follows body contours. Place the zero point of the tape on **cervicale**. Exert only enough pressure to prevent slack in the tape. The measurement is taken at the maximum point of quiet respiration.

<u>CAUTION</u>:   Be sure that the head is in the Frankfort plane and that the zero point of the tape is on the **cervicale landmark** when the measurement is made. The measurer may have to hold the tape against the subject's back to maintain skin contact.

LANDMARK(S) ENCOMPASSED: **Waist (natural indentation): right and left; posterior and anterior.**
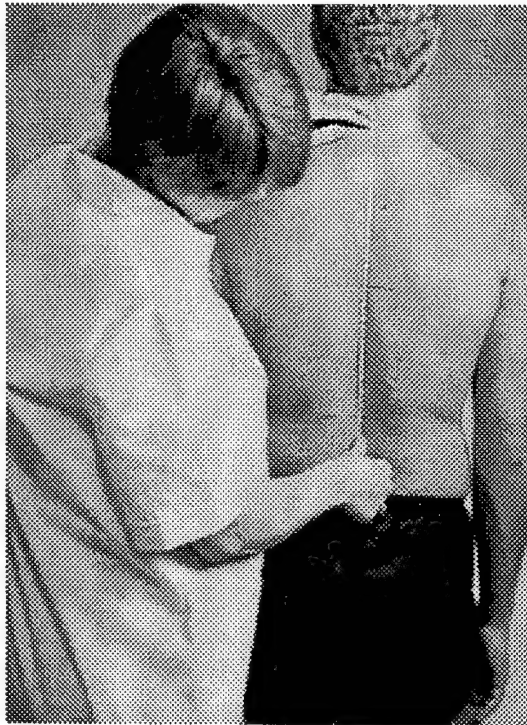
PROCEDURE: Subject is in the anthropometric standing position in front of a mirror. Stand in front of the subject and use a tape to measure the horizontal circumference at the level of the drawn **waist (natural indentation) landmarks.** (Since all the waist landmarks are established at the level of the greatest indentation on the right side, the tape passes over both landmarks regardless of where the natural indentation on the left side may actually be.) Use the mirror to check the position of the tape as it crosses the subject's back. Exert only enough tension on the tape to maintain contact between the tape and the skin. The measurement is made at the maximum point of quiet respiration.

CAUTION: The subject must not tense the abdominal muscles.
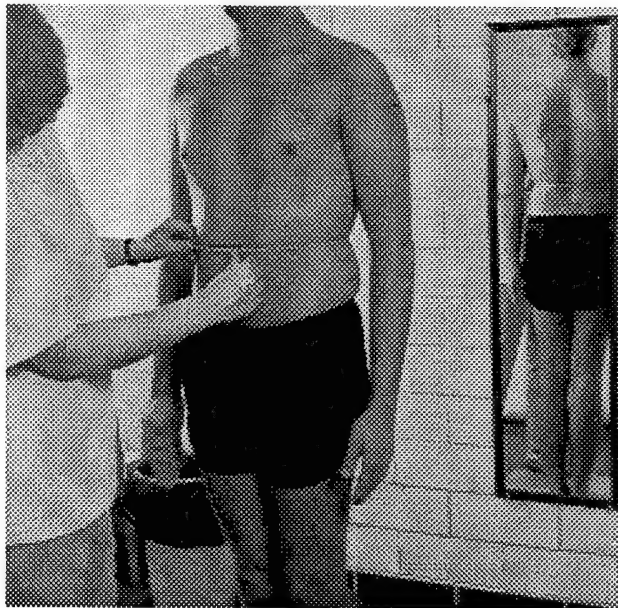
LANDMARK(S) ENCOMPASSED: **Waist (omphalion): right and left; posterior and anterior.**

PROCEDURE: Subject is in the anthropometric standing position in front of a mirror. Stand in front of the subject and use a tape to measure the horizontal distance around the torso at the level of the center of the navel. The tape will pass over the drawn **waist (omphalion) landmarks** at the front, back and sides. Use the mirror to check the position of the tape as it crosses the subject's back. Exert only enough tension on the tape to maintain contact between the tape and the body. The measurement is made at the maximum point of quiet respiration.

CAUTION: The subject must not tense the abdominal muscles.
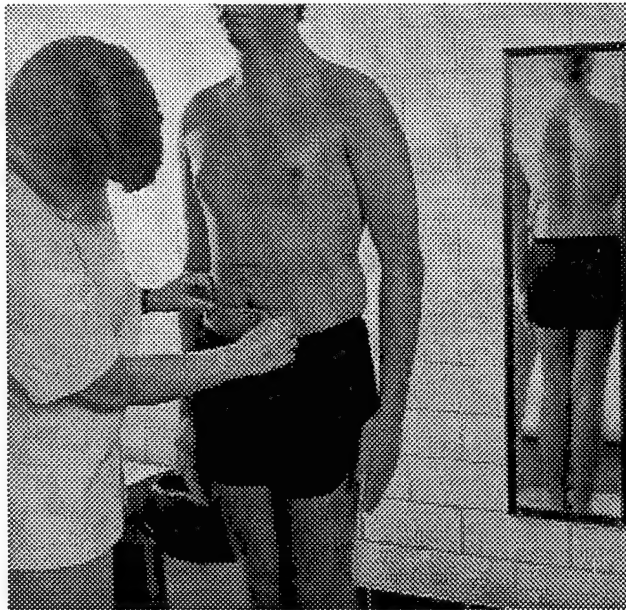
WAIST HEIGHT (NATURAL INDENTATION)

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **waist (natural indentation), right.**

<u>PROCEDURE</u>:   Subject stands in the anthropometric standing position. Stand at the right of the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn landmark at **right waist (natural indentation).** The measurement is made at the maximum point of quiet respiration.

<u>CAUTION</u>:   Subject must not be allowed to tense the abdominal muscles.
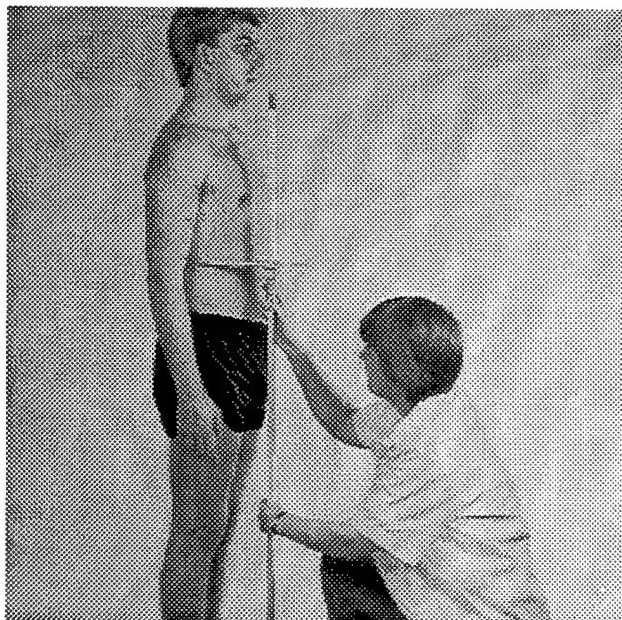
WAIST HEIGHT (OMPHALION)

<u>ORIGIN-TERMINATION</u>:   Standing surface -- **waist (omphalion), anterior.**

<u>PROCEDURE</u>:   Subject is in the anthropometric standing position. Stand in front of the subject and use an anthropometer to measure the vertical distance between the standing surface and the center of the navel [drawn **waist (omphalion) anterior landmark].** The measurement is made at the maximum point of quiet respiration.

<u>CAUTION</u>:   The subject must not be allowed to tense the abdominal muscles.
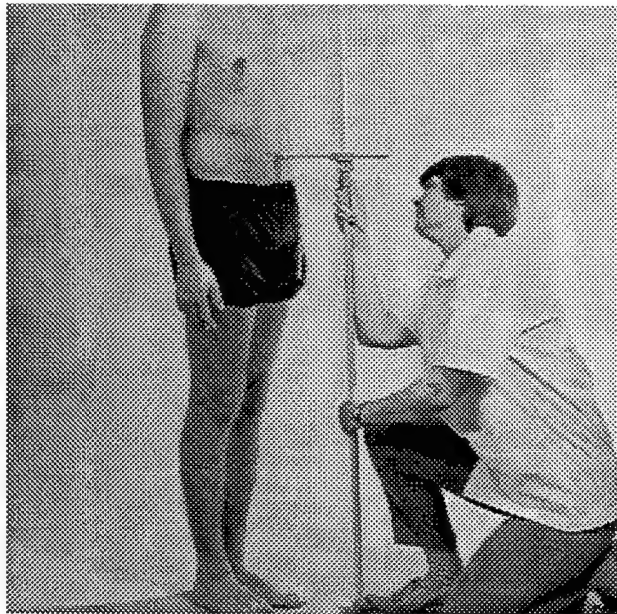
WAIST-HIP LENGTH

<u>ORIGIN-TERMINATION</u>:   **Waist (omphalion), right – buttock point, right lateral.**

<u>PROCEDURE</u>:   Subject stands on a table in the anthropometric standing position. Ask the subject to hold up the right leg of the shorts to expose the landmark. Stand at the side of the subject and use a tape to measure the vertical surface distance between the drawn landmarks at the **waist (omphalion), right** and at the **right lateral buttock point**. The subject assists in placing the tape so that it passes inside the clothing. Be sure the tape lies on the surface of the skin.
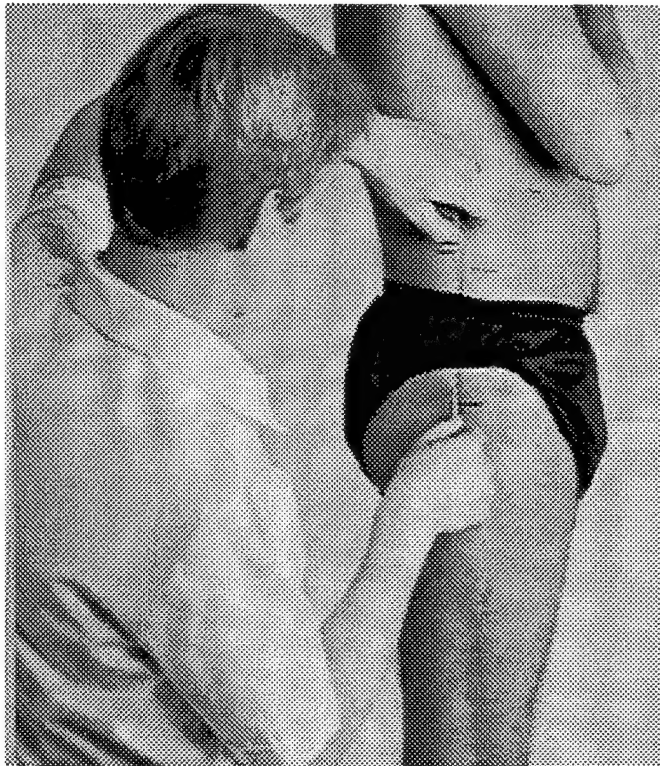
WEIGHT

PROCEDURE: Subject stands on the footprints of the platform of the scale. Stand in front of the subject and take the weight of the subject to the nearest half of a kilogram.

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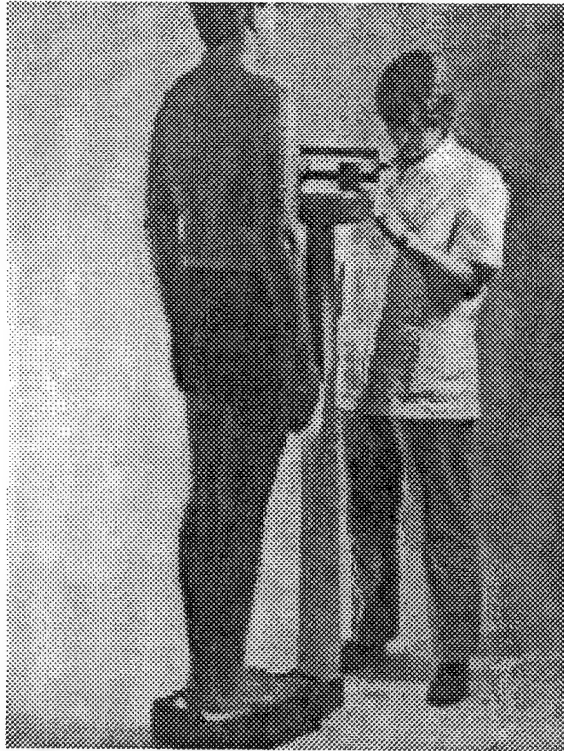
WRIST HEIGHT

ORIGIN-TERMINATION: Standing surface -- **stylion.**

PROCEDURE: Subject stands erect on a table looking straight ahead with the heels together and the weight distributed equally on both feet. The shoulders are relaxed and the arms are extended downwards with the elbow, wrist, and fingers held rigidly straight. The arms lightly touch the sides. The palms face inward (medially). Stand in front of the subject and use an anthropometer to measure the vertical distance between the standing surface and the drawn **stylion landmark** at the wrist. The measurement is taken at the maximum point of quiet respiration.

CAUTION: The subject must not be allowed to change the position of the shoulders.
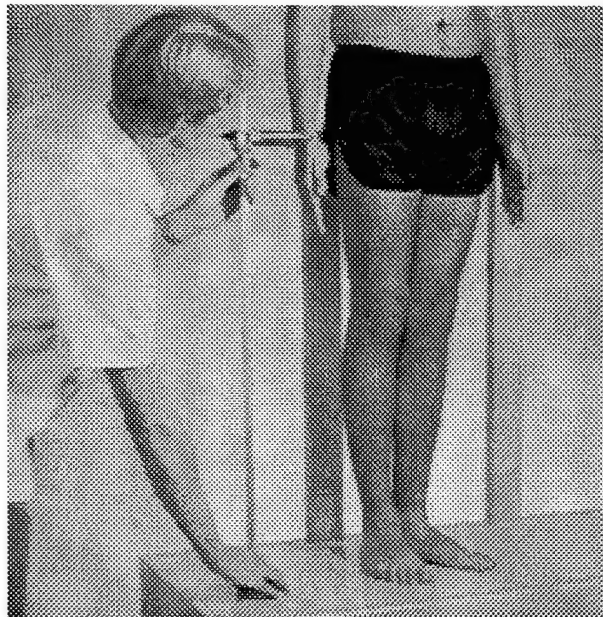
ANTHROPOLOGICAL LANDMARK DESCRIPTIONS

Acromion, right and left

DESCRIPTION: The point of intersection of the lateral border of the acromial process and a line running down the middle of the shoulder from the neck to the tip of the shoulder.

PROCEDURE: Subject is in the anthropometric standing position. Stand behind the subject and palpate the tips of both shoulders simultaneously. Draw a line along the lateral bony border of each shoulder. Then stand at the right of the subject and lay a tape on the shoulder originating at the **trapezius point** (at the base of the neck), passing so that the front edge of the tape lies over the **clavicle** (collar bone) **point,** and crosses the drawn acromial border at the tip of the shoulder. Draw a short line along the front edge of the tape where it crosses the acromial border. Repeat the process for the left shoulder.
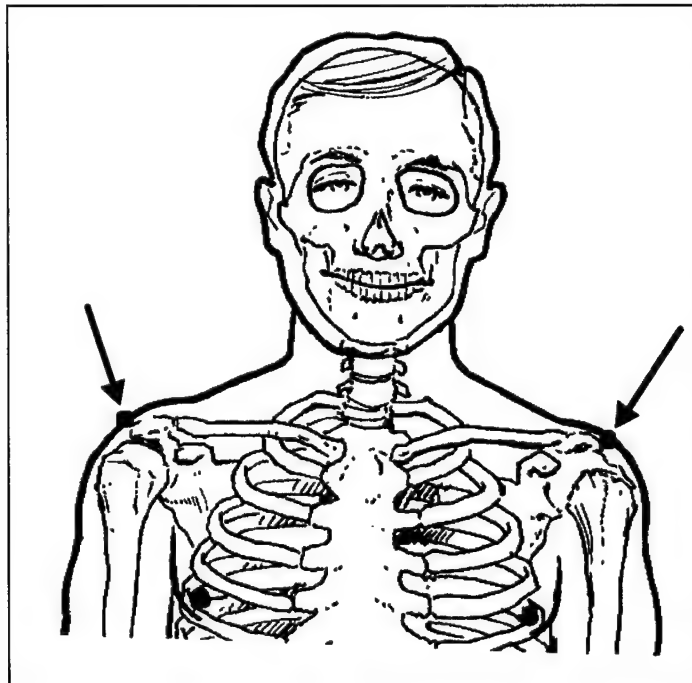
Biceps point

DESCRIPTION: The highest point of the right flexed biceps as viewed from the subject's right side.

PROCEDURE: Subject stands with the right upper arm extended forward horizontally and the elbow flexed about 90 degrees. The fist is tightly clenched and held facing the head. Stand to the right of the subject and locate the highest point on the flexed biceps by inspection. Draw a short line perpendicular to the long axis of the upper arm passing through the landmark.
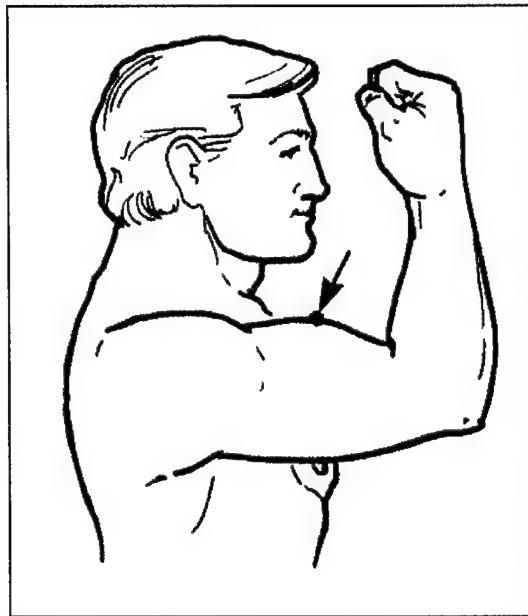
Bustpoint, right and left

DESCRIPTION: The anterior points of the bra cups.

PROCEDURE: Subject is in the anthropometric standing position. Stand at the right of the subject and sight the most protruding point of the bra over each breast. Draw a dot on each landmark.
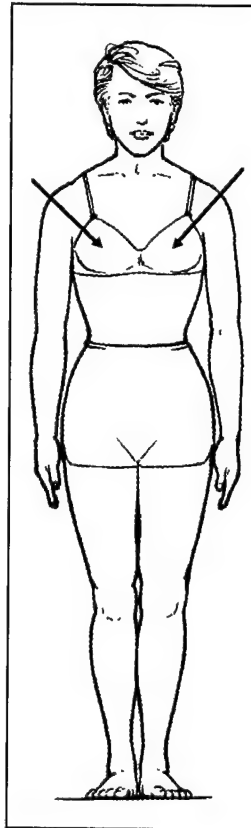
Buttock point, right lateral and left lateral

DESCRIPTION: Points at the level of the maximum protrusion of the right buttock.

PROCEDURE: Subject is in the anthropometric standing position. Stand at the right of the subject and sight the point of maximum protrusion of the right buttock (buttock point, posterior). (This landmark is not drawn.) Set the landmark transfer rod to the height of the posterior buttock landmark. Move it to the right and left sides of the subject and draw short horizontal marks on each side. On the right side, mark the line with a "B".
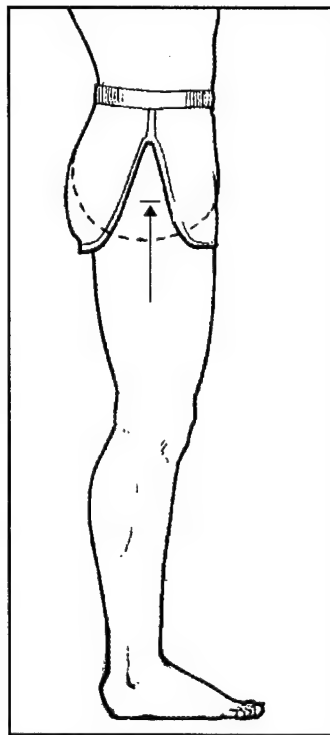
Cervicale

DESCRIPTION: The superior palpable point of the spine of the seventh cervical vertebra.

PROCEDURE: Subject is in the anthropometric standing position with the head in the Frankfort plane.   The spine of the seventh cervical vertebra is the most prominent vertebral spine of the back of the neck. It is best found by having the subject bend the head downward. Stand behind the subject and with the pad of the index finger, palpate the most prominent spine. Have the subject slowly bring the head up to the Frankfort plane while intermittently touching the spine. When the head is in place, locate the superior point of the spine of the seventh cervical vertebra. Draw a cross (+) through the landmark.

CAUTION: A few subjects will be encountered on whom no cervical spine prominence is detectable. On such subjects, estimate the point as nearly as possible with respect to the neck and shoulders. A few subjects will exhibit two or three equally prominent spinal processes. In such cases, mark the spine that is closest to the posterior base of the neck as established by a tape. Be sure that the head is in the Frankfort plane when the landmark is drawn.
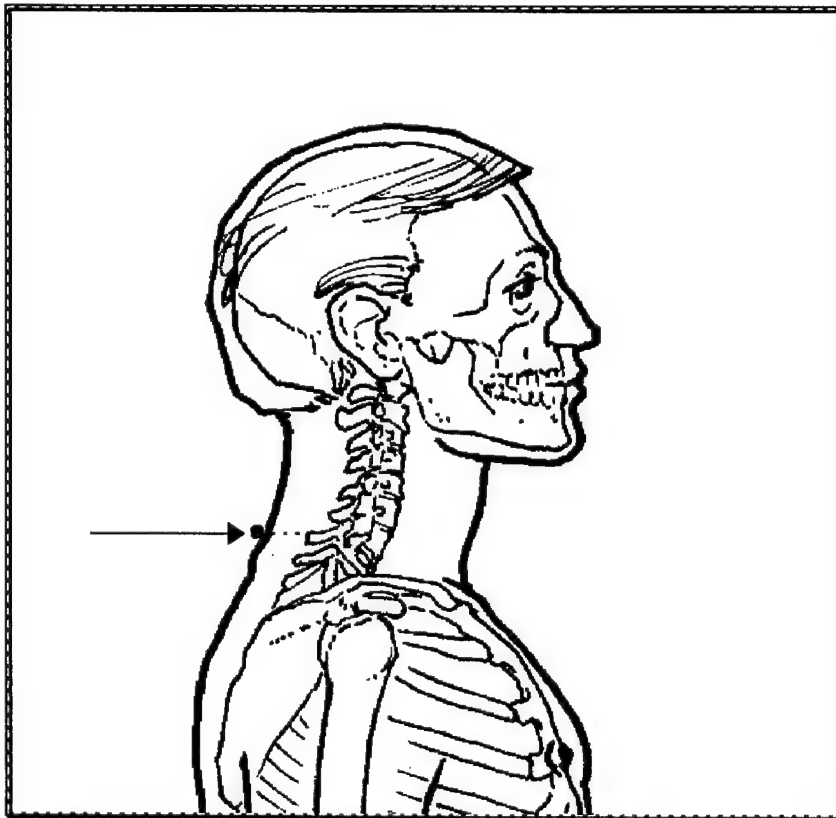
Clavicle point, right and left

DESCRIPTION: The superior points of the lateral ends of the clavicles.

PROCEDURE: Subject is in the anthropometric standing position. Stand behind the subject and palpate the top of the lateral ends of the clavicles (collar bones) near the tips of the shoulders until you locate their most superior points. Place dots over the landmarks.
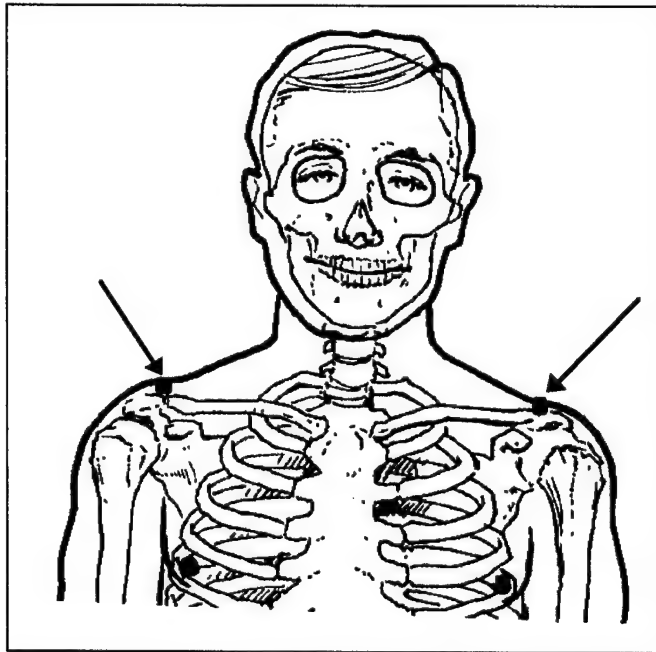
Deltoid point, right and left

DESCRIPTION: The lateral point of the right deltoid muscle, and the margin of the left deltoid muscle at the level of the right deltoid point.

PROCEDURE: Subject is in the anthropometric standing position. Stand in front of the subject and locate, by inspection, the most protruding point of the right upper arm overlying the deltoid muscle. Draw a short horizontal mark through the landmark. Use a landmark transfer rod set at the height of the right deltoid landmark to establish the location of the left deltoid landmark. Draw a short horizontal line through the left landmark.
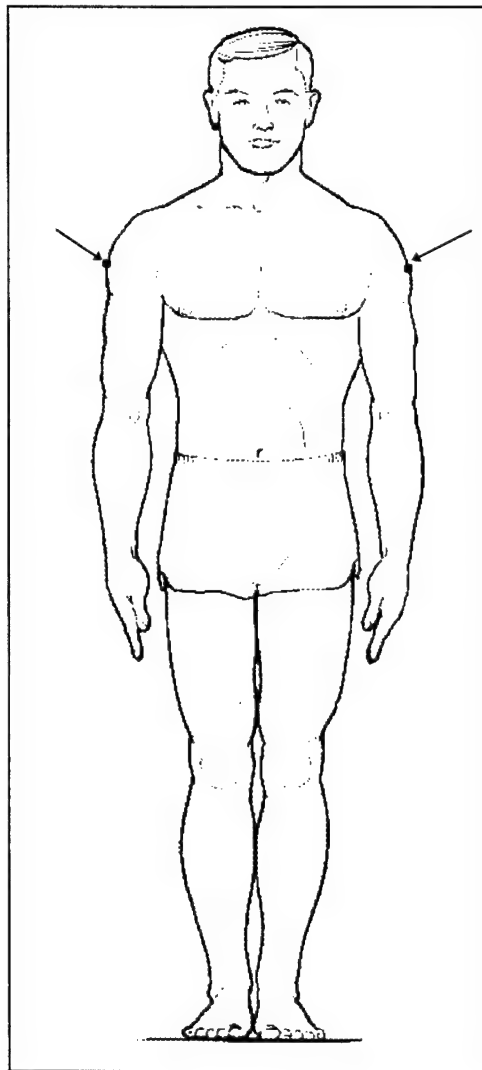
Gluteal furrow point

DESCRIPTION: The lowest point of the lowest furrow or crease at the juncture of the right buttock and the thigh.

PROCEDURE: Subject is in the anthropometric standing position. Stand behind the subject and draw a short horizontal line at the top of the thigh at the lowest point of the lowest crease. Where there is a smooth continuous curve at the juncture of the thigh and buttock, view the buttock/thigh juncture from the right side and draw the landmark where you judge it to be appropriate. Even on subjects with a continuous curve, a skin crease can usually be discerned.
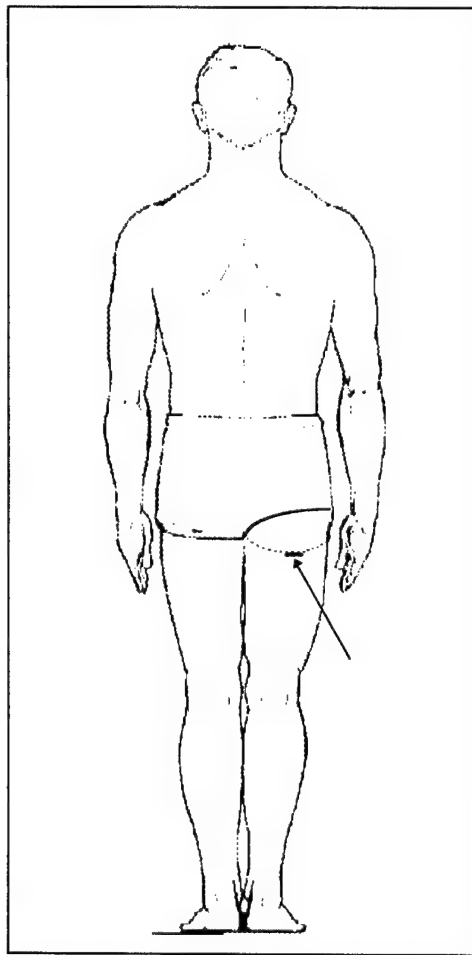
Iliocristale

DESCRIPTION: The highest palpable point of the right iliac crest of the pelvis, one half the distance between the anterior superior iliac and posterior superior iliac spines.

PROCEDURE: Subject stands in the anthropometric standing position. Stand in front of the subject. Use both hands to locate the anterior and posterior points of the iliac crests and note one half the distance between them.   At this midpoint, use the tip of the finger to move upward on the right side to locate the highest palpable point, and draw a short horizontal line through the landmark. Draw an "I" on the line.
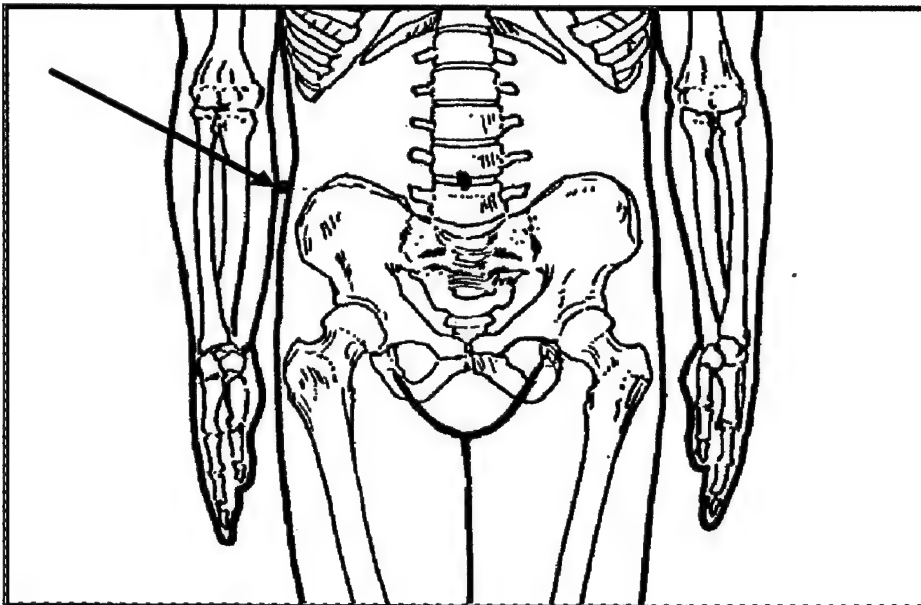
Infraorbitale

DESCRIPTION: The lowest point on the anterior border of the bony eye socket.

PROCEDURE: Subject stands, looking straight ahead. Stand in front of the subject and palpate the bony eye socket under the eye to locate its lowest point. Draw a dot on the landmark.

CAUTION: Subjects may be apprehensive when you palpate near their eyes. Care must be taken in locating this landmark to reduce the subject's concern.
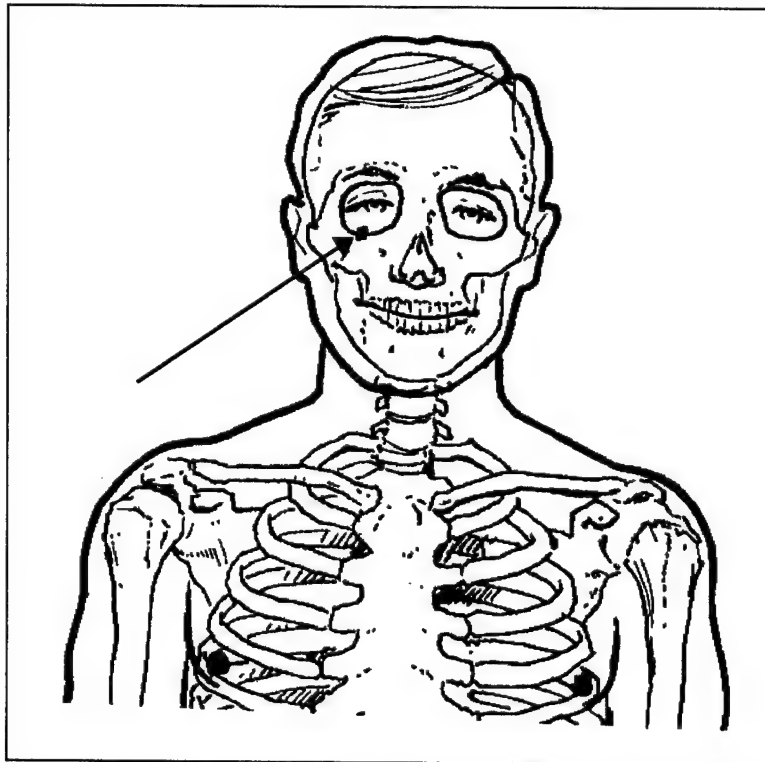
Midpatella

<u>DESCRIPTION</u>:   The anterior point halfway between the top and bottom of the right patella (the kneecap).

<u>PROCEDURE</u>:   Subject stands erect on a table with the knee <u>relaxed</u>. Stand in front of the subject. Grasp the kneecap with the forefinger on the top of the patella and the thumb on the lower edge of the patella. Establish the midpoint by sight and draw a short horizontal line through the landmark.

<u>CAUTION</u>:   Subjects commonly lock their knees when this landmark is being located. If the subject has difficulty relaxing the knee, firmly grasp the subject's thigh a few inches above the knee and then let go. This usually has the effect of relaxing the patella. If the subject is still unable to relax the knee, move on to other landmarks and then try the patella landmark again.
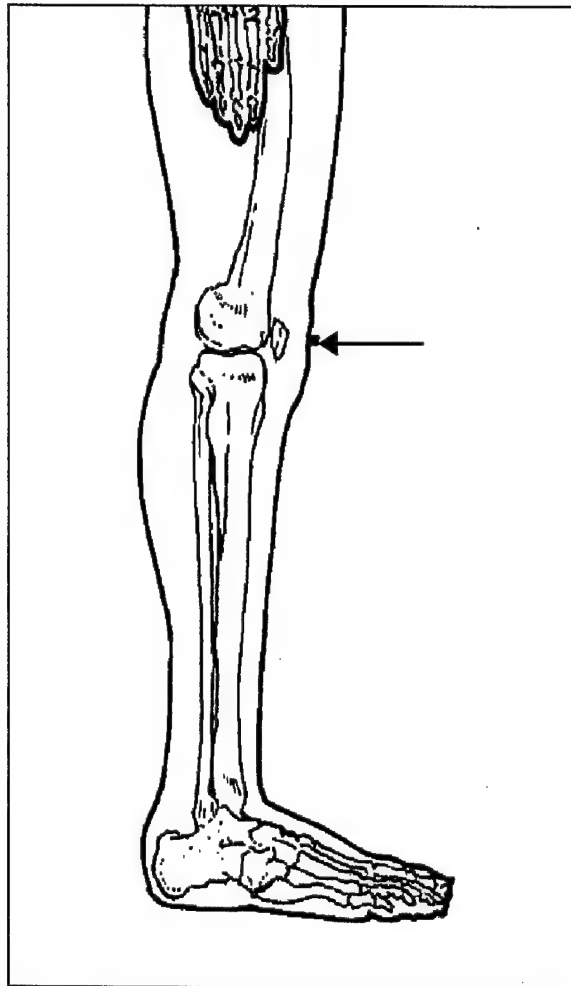
Midspine

DESCRIPTION: A line down the center of the back.

PROCEDURE: Subject is in the anthropometric standing position. Stand behind the subject. Using a plastic rule as a guide, draw a vertical line about 10 cm long down the back, in the midsagittal plane, beginning at a point about 4 cm below **cervicale** (at the base of the neck).
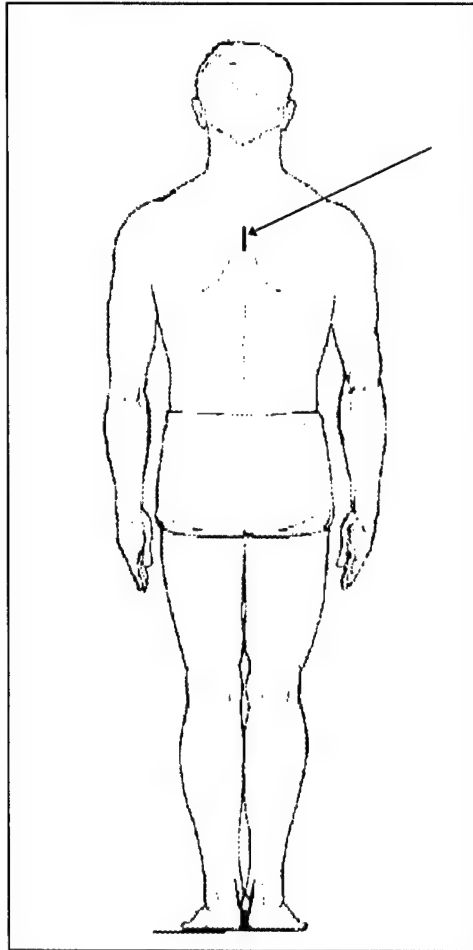
Neck: anterior, right lateral, and left lateral

DESCRIPTION: Anterior and lateral points at the base of the neck.

PROCEDURE: Subject stands looking straight ahead. Stand behind the subject. Place a tape around the base of the neck, laying it first in front, then on the sides, and finally, across the back. The anterior landmark is at the bottom of the tape, on the front of the neck in the midsagittal plane. The subject places a finger on the tape near the anterior landmark to help hold the tape in place. Draw a short horizontal line through the landmark. The right and left lateral landmarks are located at the bottom of the tape on both sides. Draw roughly 4-cm-long horizontal lines through both landmarks following the bottom of the tape.
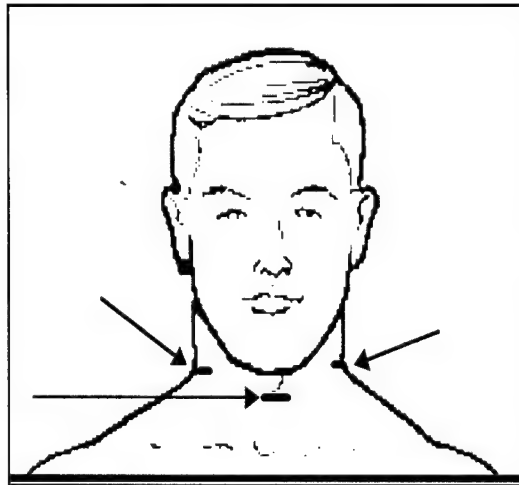
DESCRIPTION: Points on the upper arm and torso associated with the armhole of a garment.

Anterior scye on the torso (I)
Anterior scye on the upper arm (I)
Posterior horizontal scye, right and left (II)
Posterior vertical scye, right and left (II)
Posterior diagonal scye, right and left (III)
Midscye, right and left (III)
Scye level at midspine (III)

PROCEDURE: Subject is in the anthropometric standing position. The subject places the right hand on the hip.
Begin by standing in front of the subject and move around the subject as needed. Place the edge of a plastic rule
with a level firmly into the right armpit in a horizontal position and then ask the subject to carefully lower the arm
to the side, thus clamping the rule in place. Make sure the rule is level. Draw short horizontal lines on the torso
and upper arm at the top of the rule on the anterior side **(Anterior scye on the torso, Anterior scye on the upper
arm).** These marks are made on the right side only. Draw a short horizontal line on the back at the top of the rule
(Posterior horizontal scye, right). Repeat the process with the left hand on the hip and the rule in the left armpit
for the **posterior horizontal scye, left.** Then remove the plastic rule and draw short vertical lines extending
upward along the arm creases from the posterior horizontal landmarks **(Posterior vertical scye, right and left).**
Use a flexible rule to draw a line **(Posterior diagonal scye)** connecting the posterior vertical scye lines to the
corresponding **acromion landmarks.** Hold the marked edge of the rule parallel to the coronal plane. Then place a
tape in the same position, and note the distance between the scye and acromion points. Draw short horizontal lines
intersecting the diagonal at one-half the noted distance **(Midscye).** With a ruler connecting the right and left
posterior horizontal scye marks, draw a short horizontal line across the spine **(Scye level at midspine).**

CAUTION: These are some of the more difficult landmarks to locate accurately and consistently. On some
subjects the arms will have to be held farther away from the body than the hands-on-hips position to place the ruler
in its proper position. Be sure that the ruler is level when the arm is lowered to the side. If it is not, begin the
process of placing the ruler again. Do not try to level the ruler while the subject's arm is down.

I   II   III
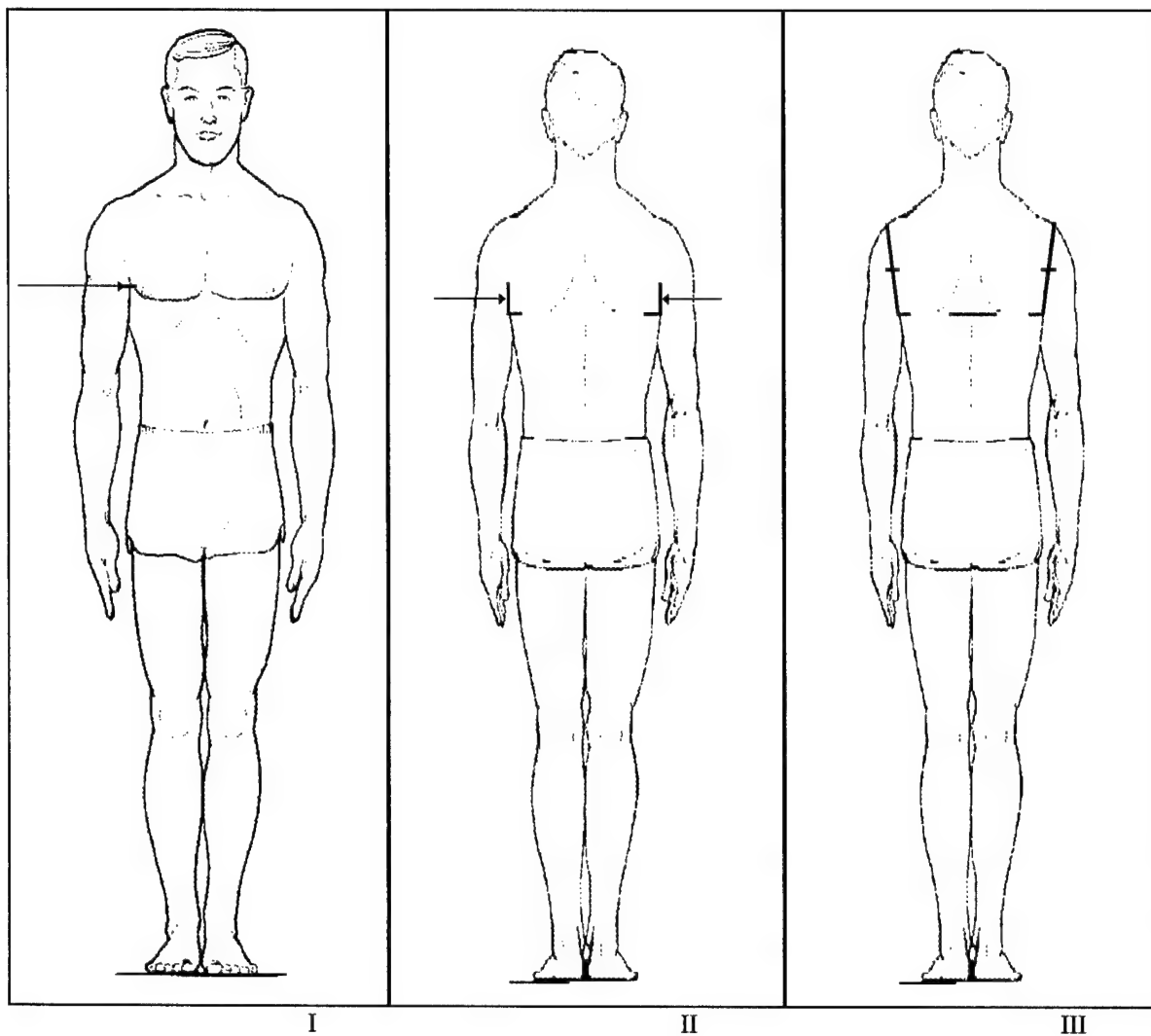
Stylion

DESCRIPTION: The lowest point of the bottom of the radius.

PROCEDURE: Subject stands. Stand in front of the subject and grasp the subject's hand. Place your thumb on the thumb side of the subject's hand and palpate up toward the wrist until you locate the end of the radius. Draw a cross (+) over the landmark.

CAUTION: This area is crossed by tendons so it may be necessary to bend the hand up and down at the wrist to find the landmark.
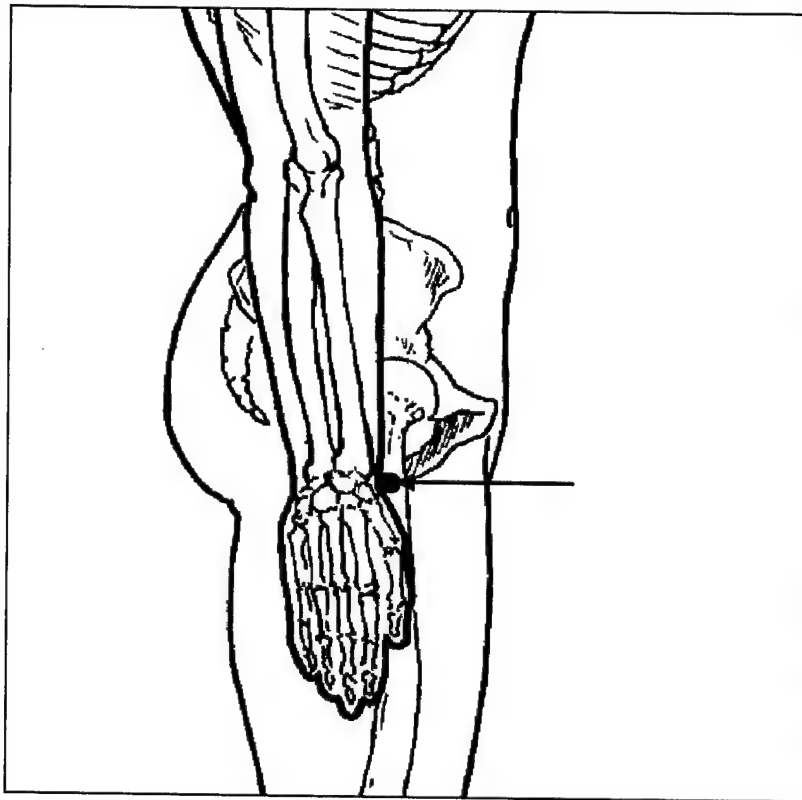
Tenth rib

DESCRIPTION: The inferior point of the right tenth rib (bottom of the rib cage).

PROCEDURE: Subject stands erect. Stand in front of the subject and begin palpating the bottom of the rib cage on the right side. Work toward the front along the bottom of the tenth rib until you locate its lowest point. Draw a short horizontal line through the landmark.

CAUTION: Subjects are often sensitive to touch in the waist area. Use firm pressure to find the deep bony structure. Avoid prolonged palpation of this area if possible.
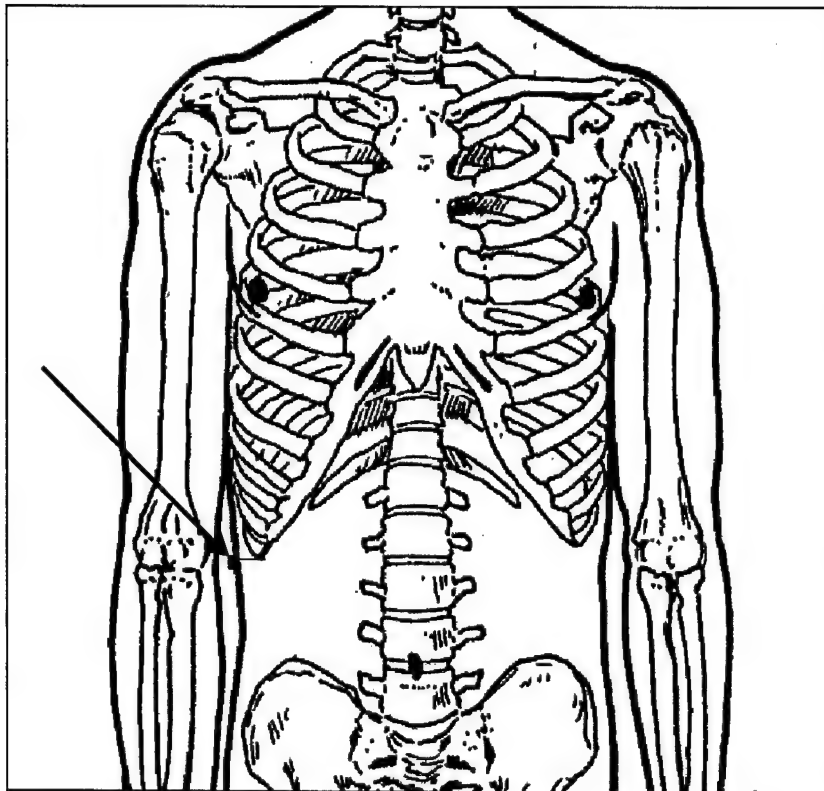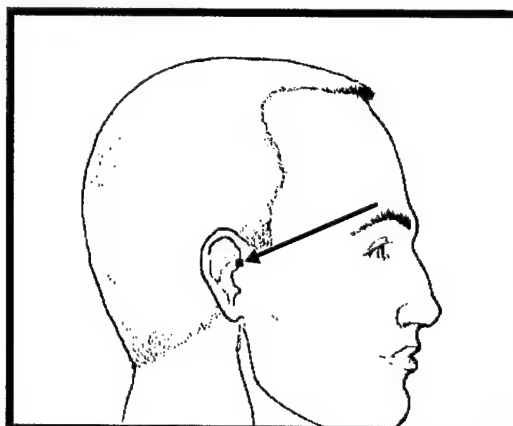
Tragion, right and left

DESCRIPTION: The superior point on the juncture of the cartilaginous flap (tragus) of the ear with the head.

PROCEDURE: Palpate each tragus to find the superior point of attachment to the head. Place a dot on each landmark.

CAUTION: Avoid distorting the soft tissue in this area while drawing the landmark.

Trapezius point, right and left

DESCRIPTION: The point at which the anterior border of the trapezius muscle crosses the **lateral neck landmark.**

PROCEDURE: Subject stands looking straight ahead. Ask the subject to place the right hand on his/her left shoulder to help outline the trapezius muscle on the right shoulder. Stand at the side of the subject. Moving from the shoulder to the neck, palpate the mass of the trapezius muscle to locate its anterior border. Draw a short line from the neck toward the shoulder at the point where the anterior border of the muscle crosses the **lateral neck landmark.** Repeat this procedure on the other side.
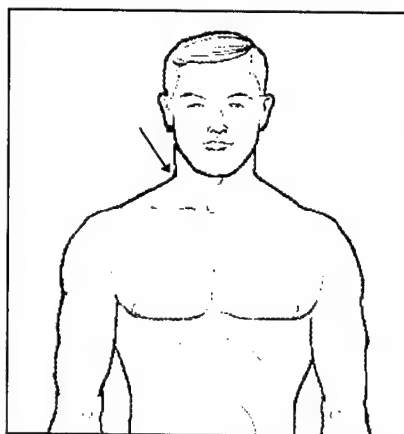
Waist (natural indentation): right and left; anterior and posterior

DESCRIPTION: The point of greatest indentation on the profile of the right side of the torso as viewed from the front of the subject, or one-half the distance between the **Tenth rib** and the **Iliocristale landmarks.**

PROCEDURE: Subject is in the anthropometric standing position. Stand in front of the subject and locate the point of maximum indentation on the right side of the waist by inspection. On some subjects there will be more than one indentation that could be identified as a "natural indentation." On these subjects, the landmark is drawn one-half the distance between the **Tenth rib** and the **Iliocristale landmarks.** On these subjects, write "1/2" beside the landmark. Draw a cross (+) on the landmark. Use a landmark transfer rod set at the height of the right waist landmark to locate corresponding landmarks on the left, front, and back of the subject. Draw 4-cm horizontal lines through these landmarks. The marks are drawn at the maximum point of quiet respiration.

CAUTION: The subject must not tense the abdominal muscles. Be sure to draw the landmarks at the maximum point of quiet respiration.
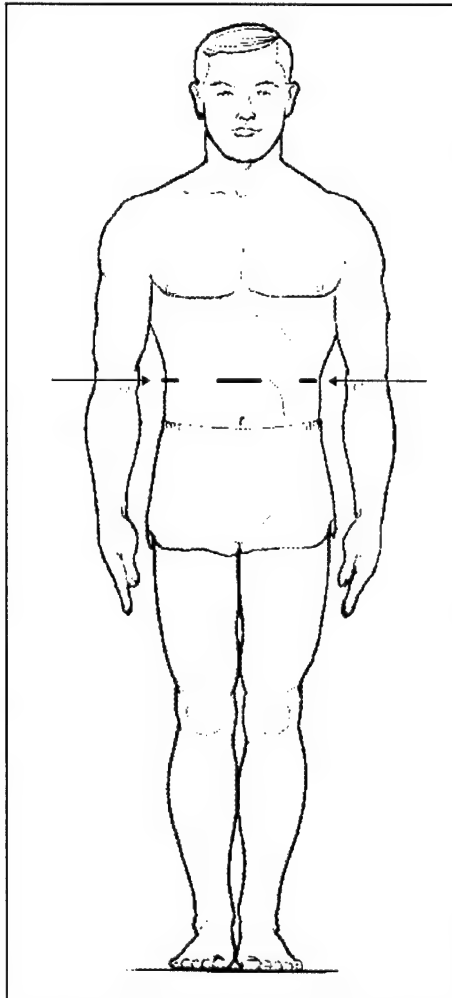
Waist (omphalion): right and left; anterior and posterior

DESCRIPTION: Center of the navel.

PROCEDURE: Subject is in the anthropometric standing position. Stand in front of the subject and locate the landmark by inspection. Draw a 4-cm horizontal line across omphalion, and using a landmark transfer rod set at the height of omphalion, draw 4-cm horizontal lines on the right and left sides and over the spine of the subject. The landmarks are drawn at the maximum point of quiet respiration.

CAUTION: The subject must not tense the abdominal muscles or change body position while these marks are drawn.
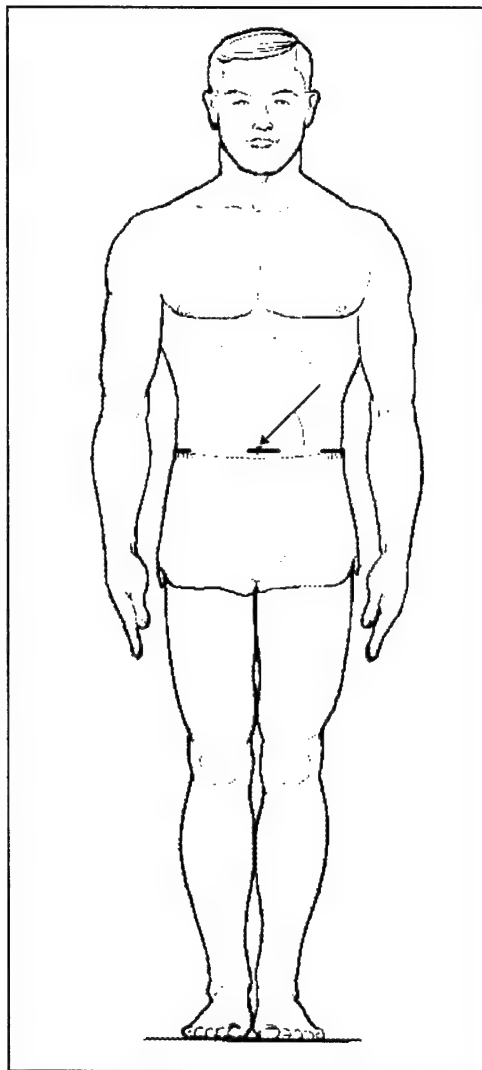
APPENDIX C

SUMMARY STATISTICS OF TEST SUBJECTS

TABLE C-1

Summary Statistics for Army Male Recruits: Anthropological Measurements
(n=60; weight in pounds, all others in inches)

DIMENSION	MINIMUM	MAXIMUM	MEAN	STD ERROR	STD DEV	SKEWNESS	KURTOSIS	ANSUR MEAN (n=1774)	ANSUR STD DEV
Acromial Height	50.20	62.91	55.86	0.364	2.82	-0.079	-0.103	56.79	2.44
Axilla Height	45.75	58.79	51.61	0.351	2.72	-0.070	-0.004	52.00	2.28
Buttock Circumference	31.89	47.24	37.85	0.385	2.98	0.421	0.363	38.73	2.45
Cervicale Height	51.97	66.76	58.92	0.373	2.89	-0.012	0.190	59.82	2.47
Chest Circumference	32.68	47.83	38.11	0.384	2.98	0.599	0.546	39.03	2.72
Coat Length①	23.73	30.24	27.36	0.182	1.41	-0.166	-0.251	.--	.--
Crotch Height	27.68	38.94	32.68	0.281	2.18	0.103	0.237	32.96	1.82
Gluteal Furrow Height	26.38	38.35	31.56	0.281	2.18	0.253	0.600	32.06	1.80
Inside Sleeve Lgth, Right①	16.30	21.11	18.73	0.165	1.28	-0.200	-0.840	18.67	1.17
Neck Height, Lateral	51.38	65.63	58.07	0.371	2.87	-0.094	0.170	59.43	2.42
Rise, NI①	9.17	13.11	11.15	0.109	0.84	-0.048	0.089	11.41	0.84
Shoulder Circumference	39.06	56.88	45.81	0.388	3.00	0.692	1.851	46.27	2.38
Shoulder Slope, Right①	1.06	3.70	2.20	0.064	0.50	0.287	0.634	.--	.--
Stature	61.22	75.98	68.37	0.397	3.07	-0.079	-0.191	69.13	2.63
Waist Circ, NI	26.81	42.48	31.86	0.398	3.08	0.720	0.918	33.07	2.91
Waist Circ, O	27.36	44.96	32.76	0.452	3.50	0.794	1.029	33.95	3.40
Waist Height, NI	37.20	50.63	43.83	0.327	2.53	-0.044	0.304	44.37	2.05
Waist Height, O	35.39	46.65	41.32	0.309	2.39	-0.134	-0.079	41.69	2.00
Weight	104.70	270.11	160.43	3.860	29.90	0.776	1.665	173.03	24.48
Wrist Height	28.90	37.68	32.88	0.242	1.88	0.240	-0.154	33.33	1.63

① Calculated dimension.

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TABLE C-2

Summary Statistics for Army Male Recruits: Tailoring Measurements
(n=60; weight in pounds, all others in inches)

DIMENSION	MINIMUM	MAXIMUM	MEAN	STD ERROR	STD DEV	SKEWNESS	KURTOSIS
Back-Floor Height	36.50	48.50	42.26	0.300	2.32	-0.065	0.244
Chest Circumference	35.00	52.00	41.25	0.414	3.21	0.634	0.788
Coat Length	27.25	33.50	30.06	0.206	1.60	0.015	-0.742
Coat Waist Circ (n=59)	28.00	45.00	33.62	0.429	3.30	0.830	1.222
Crotch Height, Left①	27.25	36.75	31.76	0.245	1.90	0.035	-0.005
Front-Floor Height	35.00	45.50	40.78	0.288	2.23	-0.226	-0.159
Height (reported)	63.00	78.00	69.55	0.425	3.29	0.032	-0.296
Inside Sleeve Length, Left	15.00	20.50	17.92	0.160	1.24	0.195	-0.380
Inside Sleeve Length, Right	15.25	20.50	18.02	0.158	1.23	0.211	-0.557
Outseam, Left	36.50	47.75	42.15	0.286	2.21	-0.154	0.228
Outseam, Right	37.00	47.50	42.22	0.285	2.21	-0.106	0.023
Overarm	41.00	57.00	47.08	0.390	3.02	0.529	0.649
Rise	8.50	12.00	10.39	0.091	0.70	-0.353	0.570
Seat	35.50	52.00	40.13	0.391	3.03	0.997	2.535
Shoulder Slope, Left	1.25	3.50	2.66	0.056	0.43	-0.765	1.701
Shoulder Slope, Right	1.25	3.50	2.65	0.065	0.50	-0.841	0.659
Waist Circumference	28.25	43.00	33.57	0.379	2.94	0.546	0.584
Weight (reported) (n=59)	111.00	270.00	163.81	3.873	29.75	0.703	1.381

① Calculated dimension.

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TABLE C-3

Summary Statistics for Army Female Recruits: Anthropological Measurements
(n=67; weight in pounds, all others in inches)

DIMENSION	MINIMUM	MAXIMUM	MEAN	STD ERROR	STD DEV	SKEWNESS	KURTOSIS	ANSUR MEAN (n=2208)	ANSUR STD DEV
Acromial Height	48.23	57.32	52.34	0.258	2.11	0.464	0.152	52.50	2.28
Axilla Height	44.33	53.46	48.40	0.245	2.01	0.499	0.472	48.57	2.14
Biceps Circ, Flexed	9.76	13.58	11.16	0.111	0.91	0.604	-0.319	11.08	0.89
Bust Position①	11.52	15.45	13.27	0.120	0.99	0.123	-0.862	--	--
Buttock Circumference	33.74	44.03	38.34	0.276	2.26	0.202	-0.428	38.07	2.37
Cervicale Height	50.12	60.04	54.89	0.267	2.18	0.256	-0.002	55.43	2.33
Chest Circumference	29.57	44.09	36.21	0.316	2.59	0.309	0.521	35.71	2.50
Chest Height	42.01	51.46	46.27	0.244	2.00	0.342	0.530	46.24	2.17
Chest Circ, Scye	30.79	39.72	35.77	0.264	2.16	-0.007	-0.692	34.92	2.10
Coat Length①	23.62	28.82	25.77	0.133	1.09	0.184	-0.195	--	--
Crotch Height	27.13	35.55	30.81	0.213	1.75	0.361	0.061	30.37	1.74
Front Waist Length, O①	19.17	23.75	21.23	0.148	1.21	0.256	-0.966	--	--
Gluteal Furrow Height	24.96	33.66	29.12	0.221	1.81	0.164	-0.142	29.30	1.69
Inside Sleeve Lgth, Right	15.16	20.83	17.50	0.146	1.19	0.682	0.840	17.45	1.16
Interscye II	12.99	16.73	14.93	0.112	0.91	0.045	-0.827	14.81	0.95
Knee Height, Midpatella	14.96	20.94	17.77	0.128	1.05	0.273	1.223	18.06	1.03
Neck Height, Lateral	49.72	59.09	54.07	0.262	2.14	0.314	0.127	54.98	2.30
Rise, NI①	8.39	12.20	10.20	0.095	0.77	0.073	0.177	11.23	0.93
Shoulder Slope, Right①	0.91	2.32	1.73	0.034	0.28	-0.543	0.711	--	--
Skirt Length, NI①	20.63	26.57	23.24	0.150	1.23	0.148	0.129	--	--
Stature	59.13	69.29	63.76	0.274	2.25	0.396	0.232	64.15	2.50
Strap Length	23.03	30.91	26.53	0.241	1.97	0.123	-0.862	26.72	1.82
Waist Circ, NI	24.37	36.54	28.97	0.296	2.42	0.643	0.674	28.56	2.48
Waist Circ, O	25.83	40.39	31.32	0.386	3.16	0.525	0.032	31.18	3.26
Waist Height, NI	36.46	46.26	41.01	0.253	2.07	0.173	0.150	41.60	2.04
Waist Height, O	33.31	42.56	38.30	0.232	1.90	-0.078	0.100	38.67	1.92
Weight	105.84	198.45	138.20	2.267	18.56	0.565	0.404	136.72	18.41
Wrist Height	27.64	33.58	30.90	0.161	1.31	0.062	-0.362	31.11	1.52

① Calculated dimension.

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TABLE C-4

Summary Statistics for Army Female Recruits: Tailoring Measurements
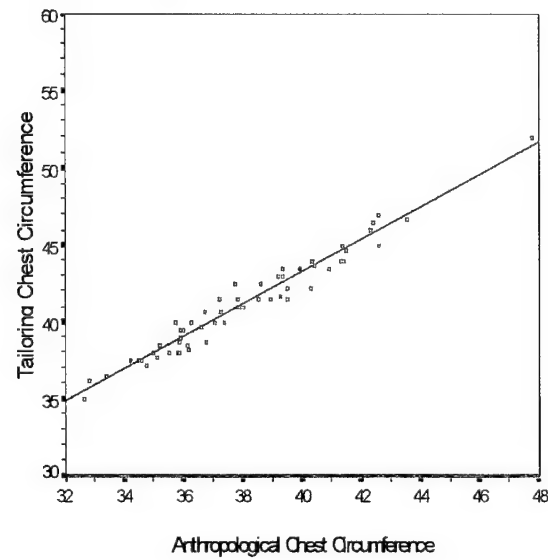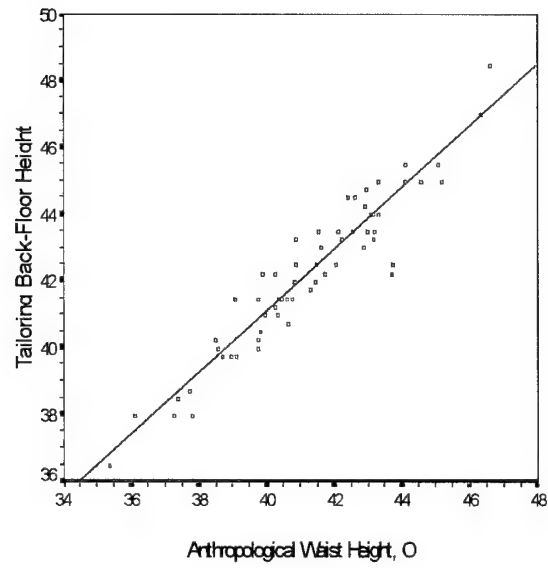(n=67; weight in pounds, all others in inches)

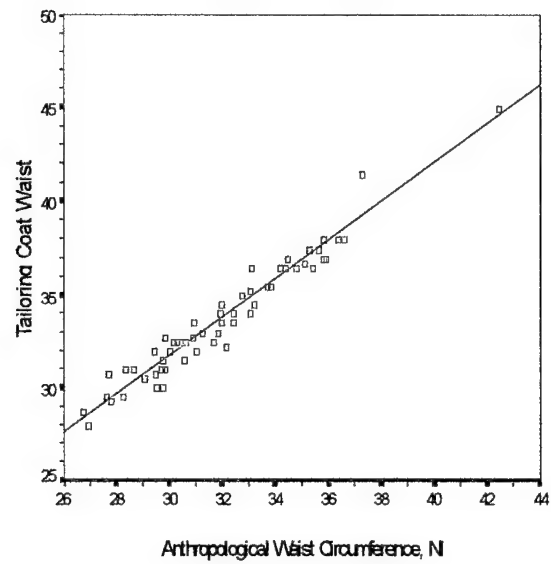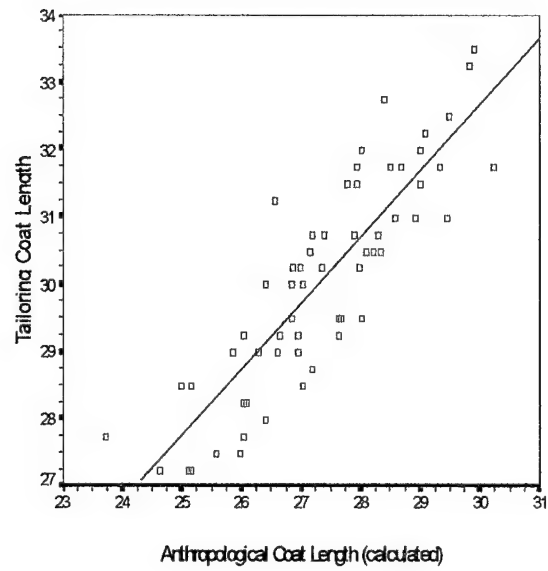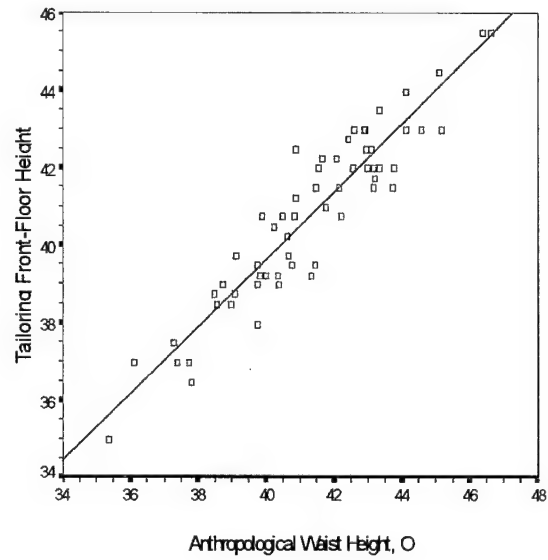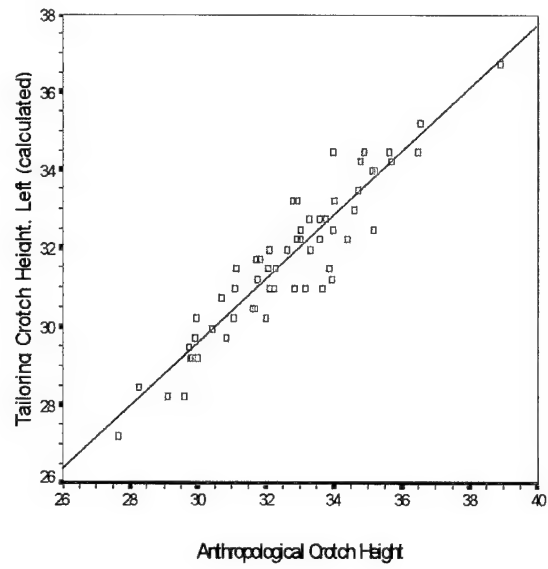| DIMENSION	MINIMUM	MAXIMUM	MEAN	STD ERROR	STD DEV	SKEWNESS	KURTOSIS
Back-Floor Height	35.75	45.25	41.04	0.234	1.92	-0.456	0.913
Biceps Circ, Flexed	10.25	14.00	11.78	0.115	0.94	0.427	-0.362
Bust Circumference	31.50	45.00	37.56	0.299	2.44	0.349	0.267
Bust Position	12.50	16.25	14.06	0.120	0.98	0.267	-0.677
Chest Circumference	32.50	42.25	36.64	0.246	2.01	0.319	-0.166
Coat Length (n=57)	25.75	29.75	27.51	0.141	1.07	0.263	-0.899
Crotch Height, Left①	25.75	34.50	30.94	0.221	1.81	-0.426	0.640
Front-Floor Height	33.50	43.75	39.89	0.248	2.03	-0.563	1.064
Front Waist Length	19.00	24.75	21.71	0.168	1.38	0.307	-0.487
Height (reported)	60.00	70.50	64.45	0.292	2.39	0.372	0.122
Inside Sleeve Length, Left	14.75	20.00	17.10	0.137	1.12	0.336	-0.119
Inside Sleeve Length, Right	14.75	20.00	17.20	0.138	1.13	0.355	-0.032
Outseam, Left	35.75	45.25	41.40	0.238	1.95	-0.468	0.724
Outseam, Right	35.75	45.50	41.50	0.239	1.96	-0.410	0.943
Point to Point	16.75	19.50	17.88	0.090	0.73	0.148	-0.957
Rise	9.00	11.75	10.46	0.067	0.55	-0.249	-0.084
Seat	35.25	44.75	39.96	0.258	2.11	0.052	-0.451
Shoulder Slope, Left	1.50	3.00	2.48	0.039	0.32	-0.223	0.103
Shoulder Slope, Right	1.25	3.50	2.47	0.047	0.39	-0.301	1.026
Skirt Length (n=66)	21.00	26.50	24.08	0.150	1.22	-0.460	0.178
Waist Circumference	25.50	37.50	30.84	0.301	2.47	0.365	0.119
Weight (reported)	106.00	204.00	137.58	2.336	19.12	0.771	0.836

① Calculated dimension.

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APPENDIX D

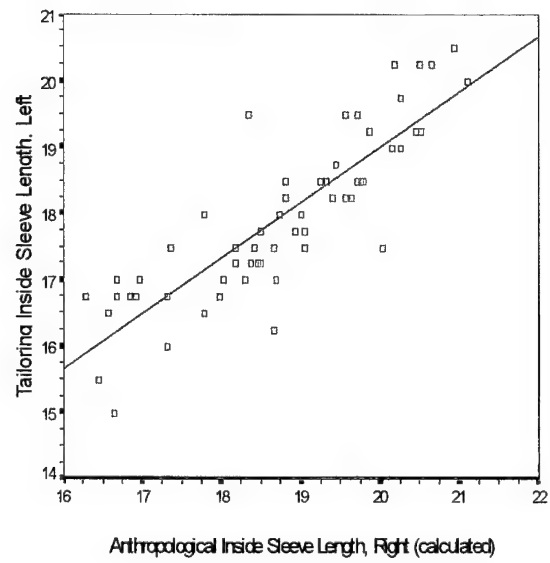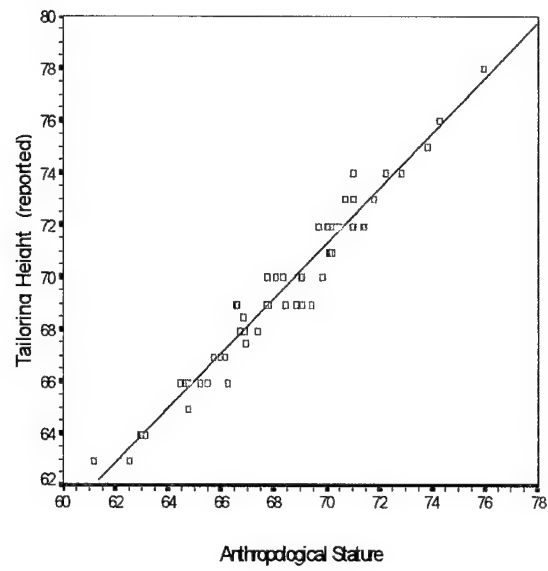PLOTS OF ANTHROPOLOGICAL AND TAILORING VALUES
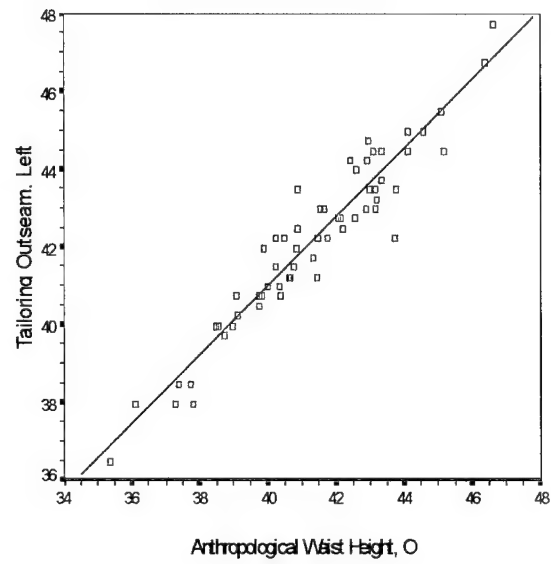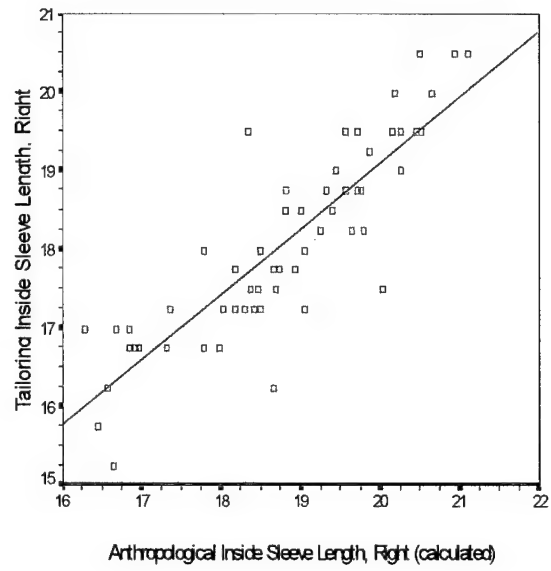DISTRIBUTED AROUND REGRESSION LINES:
MALES AND FEMALES

MALES

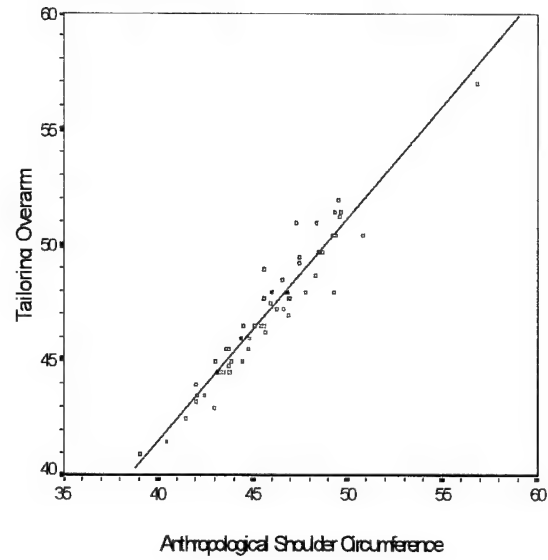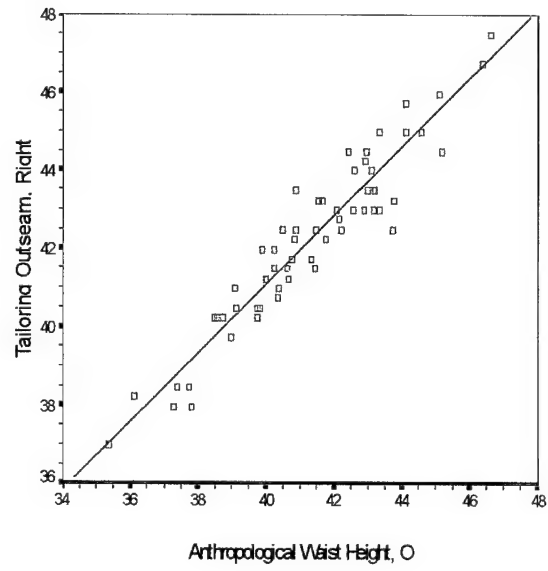

Tailoring Back-Floor Height vs Anthropological Waist Height, O

Tailoring Chest Circumference vs Anthropological Chest Circumference

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Tailoring Inside Sleeve Length, Right

Anthropological Inside Sleeve Length, Right (calculated)

Tailoring Outseam, Left

Anthropological Waist Height, O

Tailoring Outseam, Right vs. Anthropological Waist Height, O

Tailoring Overarm vs. Anthropological Shoulder Circumference

Anthropological Rise, NI (calculated)

Tailoring Buttock Circumference

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Anthropological Waist Circumference, O

Anthropological Weight

FEMALES

141

Anthropological Chest Circumference, Scye

Anthropological Coat Length (calculated)

143

Anthropological Front Waist Length, O (calculated)

Anthropological Stature

144

Anthropological Inside Sleeve Length, Right (calculated)

Anthropological Inside Sleeve Length, Right (calculated)

146

Tailoring Seat Circumference vs. Anthropological Buttock Circumference

Tailoring Shoulder Slope, Left vs. Anthropological Shoulder Slope, Right (calculated)

148

Anthropological Shoulder Slope, Right (calculated)

Anthropological Skirt Length, N (calculated)

Anthropological Waist Circumference, NI

Anthropological Weight

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